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BUTTE URBAN TRANSPORTATION STUDY

TECH - PLAN

REPORT NO. 3

FORECAST YEAR:
LAND USE DISTRIBUTIONS,
TRIP GENERATION,
TRAFFIC ASSIGNMENT TO EXISTING
PLUS COMMITTED SYSTEM

JUNE, 1973

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URBAN TRANSPORTATION STUDY
TECH PLAN REPORT NUMBER 3

FORECAST YEAR:
LAND USE DISTRIBUTIONS,
TRIP GENERATIONS,
TRAFFIC ASSIGNMENT TO EXISTING PLUS COMMITTED SYSTEM

Prepared by

CLETE DAILY AND ASSOCIATES

for

MONTANA DEPARTMENT OF HIGHWAYS
PLANNING AND RESEARCH BUREAU
and
TRANSPORTATION TECHNICAL ADVISORY COMMITTEE

in cooperation with

U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

BUT: 610.4

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Technical Advisory Committee
Butte Urban Transportation Study
Butte, Montana

Gentlemen:

Enclosed herewith is Tech Plan Report Number 3, covering the 1990 land use distributions, trip generation, and the traffic assignment of 1990 travel to the existing plus committed highway system. This report is the last in a series of three technical reports published to document in detail the specific work activities of the study.

Comments on a draft of this report were solicited from the Technical Advisory Committee, the Montana Department of Highways, and the Federal Highway Administration. Approvals of the draft were received prior to printing of this report.

Our appreciation is extended to each of the aforementioned agencies for their assistance in preparation of this report.

Respectfully submitted,
CLETE DAILY AND ASSOCIATES
Clete Daily
Clete Daily, P.E.

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CHAPTER I

INTRODUCTION

INTRODUCTION

The purpose of this report is to document in detail the assumptions and procedures used in forecasting and distributing the 1990 social-economic variables, computation of 1990 trips, and the assignment of 1990 travel to the existing plus committed highway system. Two other Tech Plan reports have been published to describe preparation of the base year (1970) trip file and calibration of the transportation planning models. The work activities covered in those two reports are as follows:

Tech Plan Report Number 1: "Travel Surveys"

- Methods and Procedures used in Conducting the Travel Surveys
- Travel Survey Edits and Expansion
- 1970 Population and Employment
- Accuracy Checks

Published September, 1972

Tech Plan Report Number 2: "1970 Traffic Assignment, Trip Generation, Gravity Model Calibration"

- Preparation of the 1970 Highway Network
- Traffic Assignment to 1970 Network
- Trip Generation Analyses
- Gravity Model Calibration

Published May, 1973

This report is the third in a series of three Tech Plan Reports that are being prepared to document all work activities leading to preparation of a transportation plan for the Butte urban area.

The development and adoption of a transportation plan is the first step in the continuing, comprehensive, and cooperative transportation planning process. Following publication of the transportation plan by Clete Daily and Associates, other reports may be prepared by the Montana Department of Highways or other agencies to reflect changes in employment, population, and land use trends.

Specific work elements of this report are covered in detail in Chapters II through VI.

Chapter II lists detailed definitions for the technical terms which are used through this report. Terms previously defined in Tech Plan Reports 1 and 2 are used in this report without explanation.

Chapter III presents the assumptions and methods used in forecasting 1990 population, employment, and dwelling units. Having determined the projected totals, they were allocated to traffic analysis zones based on the 1990 land use plan. Other social-economic variables required by the trip generation equations were also determined for each zone. The final zonal distributions for each variable are presented in tabular form.

Chapter IV describes calculation of the 1990 trip productions and attractions. The zone values of the social-economic variables (obtained in Chapter III) were input to the trip generation equations. Growth factor techniques were used for special zones. Resulting 1990 productions and attractions per zone are presented in Table IV-2.

Chapter V discusses the changes that were necessary to update the

1970 highway network to the existing plus committed network. The agencies contacted are also listed.

Chapter VI covers the traffic assignment of 1990 trips to the existing plus committed highway network. Forecasted travel is compared with 1972 average daily traffic. Figure VI-1 illustrates changes in 1990 traffic volumes. A service volume analysis was performed to determine the routes that need upgrading to meet 1990 travel demands.

Using the results of the 1990 traffic assignment to the existing plus committed system, the alternate 1990 system testing began. Procedures used and the three (3) systems tested will be discussed in the fourth report of this transportation study, entitled, "Butte Urban Transportation Plan".

CHAPTER II

DEFINITIONS

DEFINITIONS

Tech Plan Reports Number 1, "Travel Surveys" and Number 2, "1970 Traffic Assignment, Trip Generation, Gravity Model Calibration" contained glossaries of terms common to each report. Those terms are used without further explanation in this report.

Comprehensive Plan - A general plan consisting of a land use plan, a thoroughfare plan, a community facilities plan, and a public improvements program.

Forecasting - The process of determing the value of a variable at some future date. In this study the number of dwelling units, persons employed, and total population were forecasted for 1990.

Land Use Categories - The "Standard Land Use Coding Manual" classifies the various types of land uses into nine (9) categories. They are as follows:

1. Residential - all single family and multi-family living units.
2. Manufacturing - food, textile, apparel, lumber, furniture, and fixtures.
3. Manufacturing - rubber and plastic products, stone, clay and glass, metals, professional instruments, photographic and optical goods, watches and clocks, and miscellaneous manufacturing.
4. Transportation, Communication, Utilities - covers all modes of transportation, communication and utilities.

5. Trade - wholesale and retail trade.
6. Services - finance, insurance, real estate, personal, business, repair, professional, contract construction, governmental, education, and miscellansous services.
7. Cultural, Entertainment, and Recreation - all types of cultural entertainment, public assembly, amusements, parks and recreation.
8. Resource Production and Extraction - agriculture, forestry, fishing and mining.
9. Undeveloped land and water areas - all undeveloped and unused land, noncommercial forest, development, water areas, vacant floor area, and areas under construction.

The "Standard Land Use Coding Manual" further subdivides these categories using a total of four (4) digits. The reader is referred to the Manual for further information.

Land Use Distribution - The process of allocating future land uses and the associated social-economic variables to specific land areas within the study boundary. Areas used in this study were traffic analysis zones.

Select Link Analysis - The process of choosing a particular network link and examing in depth the origins and destinations of all trips crossing that link. The paths of each of those trips are traced through the entire network.

CHAPTER III

1990 FORECASTS AND DISTRIBUTIONS

1990 FORECASTS
AND
DISTRIBUTIONS

POPULATION, EMPLOYMENT, AND DWELLING UNIT FORECASTS

Tech Plan Report Number 1, "Travel Surveys" reported 1970 population, employment, and dwelling unit figures for the Butte Urban Transportation Study Area. They were as follows:

TABLE III-1

1970 POPULATION, EMPLOYMENT, DWELLING UNITS

Population	39,433
Employment	13,488
Dwelling Units	
(occupied and vacant)	15,065
(occupied)	13,680

Procedures for arriving at the above figures were explained in the "Travel Surveys" report. A zonal breakdown of these values was required input for the trip generation analyses. They are presented in Tables A-1 and A-2 of Tech Plan Report Number 2, entitled, "1970 Traffic Assignment, Trip Generation, Gravity Model Calibration".

1990 travel in the Butte study area was assumed to be dependent upon forecasted values of the social-economic variables, and land use distribution patterns. A comprehensive plan was prepared for the Butte - Silver Bow City - County Planning Board by consultant, Howard, Needles,

Tammen, and Bergendoff during 1969-1971. That plan contained projections and a future land use plan. The Technical Advisory Committee agreed to use the forecasts contained in the Comprehensive Plan as input to the Transportation Study. Consultant Clete Daily and Associates recommended to the Technical Advisory Committee that some adjustments be made to the projections given in the Comprehensive Plan. These adjustments and resultant forecasts are described in the following paragraphs.

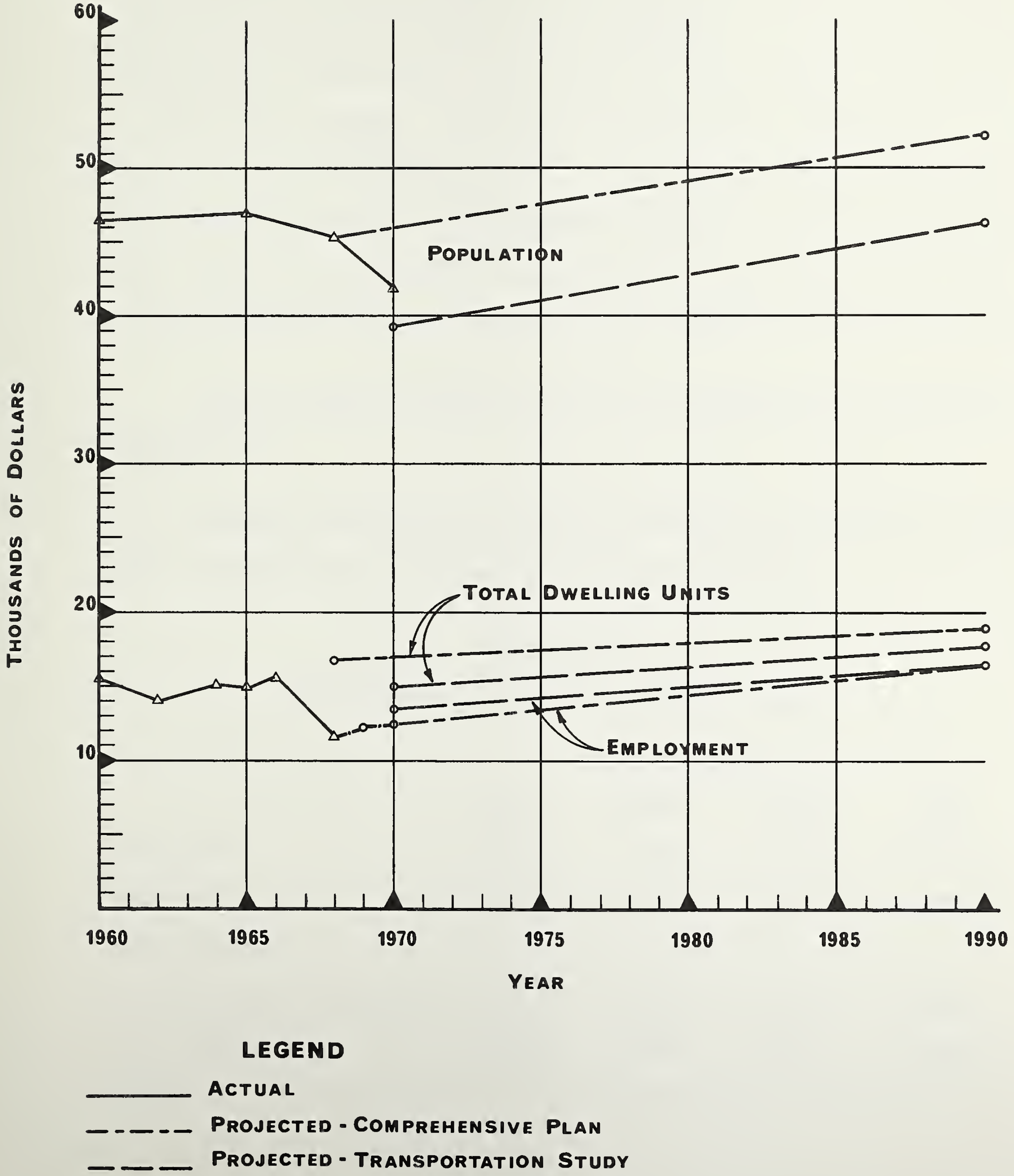
The 1990 Land Use Plan Report states that there were 45,400 residents in Silver Bow County in 1968, and predicted a growth of 6700 persons by the year 1990. However, this estimate of 45,400 was either substantially high or the county lost about 3400 residents between 1968 and 1970. The United States Census Bureau lists 41,981 persons in the county during April, 1970, while results of the Transportation Study indicate 39,433 residents for the urban study area. Using the predicted growth of 6700 urban residents from the Comprehensive Plan, a study area population of 46,133 was obtained for 1990. The increase is 17.0 percent. Figure III-1 illustrates the projected population growth.

Dwelling units are expected to increase at nearly the same rate as the population. Two thousand, two hundred-fifty (2250) new occupied units are forecast in the Comprehensive Plan, representing an increase of 17.4 percent. Adding 2250 units to the 1970 value of 13,680, the number of 1990 total occupied households is 15,930. Assuming a vacancy rate of 10.0 percent, total housing for 1990 is 17,712 dwelling units.

As explained in the first Tech Plan Report, 1970 employment was obtained by the consultant using Employment Security records and telephone

FIGURE III-1

FORECASTS OF POPULATION, EMPLOYMENT, AND DWELLING UNITS



contact. The resultant value of 13,488 employees compares with 12,500 from the Comprehensive Plan. The Plan predicts 16,500 employees for 1990, or an increase of 32.0 percent. This is considerably higher than the percentage of growth for population and households. Comparing the adjusted employment of 13,488 with a 1990 value of 16,500 employees, the increase is 3012 or 22.3 percent. Clete Daily and Associates recommended, and the Technical Advisory Committee agreed, to use the 1990 total of 16,500 from the Comprehensive Plan. This percentage increase is about 5 percent higher than those for dwelling units and population. Due to the national trend of more women entering the labor force, 22.3 percent was considered reasonable.

Growth patterns for dwelling units and employees are illustrated in Figure III-1.

Projected increases and resultant 1990 totals for population, dwelling units and employment are summarized in the table below:

TABLE III-2

1990 POPULATION, EMPLOYMENT, DWELLING UNITS

		Increase		
	1970	Number	Percent	1990
Population	39,433	6700	+17.0	46,133
Employment	13,488	3012	+22.3	16,500
Dwelling Units				
(occupied & vacant)	15,065	2647	+17.5	17,712
(occupied)	13,680	2250	+16.4	15,930

LAND USE DISTRIBUTIONS

It was necessary to distribute 1990 population, employment, and dwelling units to the appropriate traffic analysis zones. The Comprehensive Plan calls for shifts in the distributions brought about by expanding mining activities and movement of population and commercial activity to the suburban "flats" area. The 1990 Land Use Plan as adopted by the City-County Planning Board accounts for these shifts and illustrates areas for each major type of land use. That plan, with only a few exceptions as explained in the next paragraph, was used to distribute the 1990 social-economic variables.

Generally, the 1990 Land Use Plan calls for continued growth of residential uses in existing and developing residential areas with a gradual shift of some population to the southern "flats" area. The plan calls for a shift of 800,000 square feet (40 percent) of commercial floor space from the existing central business district to a diversified commercial center located on the west side of Harrison Avenue across from the airport. The plan also calls for an industrial park located further south on Harrison Avenue. These shifts represent major changes in the employment distributions.

Distributions were first made strictly in accordance with the proposed 1990 Land Use Plan. The 1990 travel was generated, distributed, and assigned to the existing plus committed highway system. The proposed commercial and industrial employment shifts caused drastic changes in the existing travel patterns. Most streets north of the interstate

showed 1990 traffic volumes to be nearly the same or less than 1972 volumes. Streets south of the interstate showed heavy increases indicating that a significant number of improvements would be required to handle 1990 traffic. Some routes north of IR15-90 also showed drastic changes. Harrison Avenue showed decreases of up to 8000 vehicles per day.

After analysing the results of the traffic assignment, the Technical Advisory Committee and the Butte Transportation Policy Committee decided to revise the 1990 Land Use Plan. Basis of the decision was that relocation of the central business district was presently under study and neither a plan for relocation nor a site had been chosen. It was not considered desirable to develop a long range transportation plan based on an assumed location for a new central business district. If relocation becomes a reality, adjustments will be made as part of the continuing plan.

The revised land use plan is the same as the first Land Use Plan except that the diversified commercial center is developed as moderate commercial strip growth and the present central business district is shown as being in its present state with only a slight increase in the intensity of use. The revised 1990 Land Use Plan is illustrated in Figure III-2.

The 1990 population, dwelling units, and employment were distributed to traffic analysis zones in accordance with the revised 1990 Land Use Plan. Procedures are presented on the following pages.

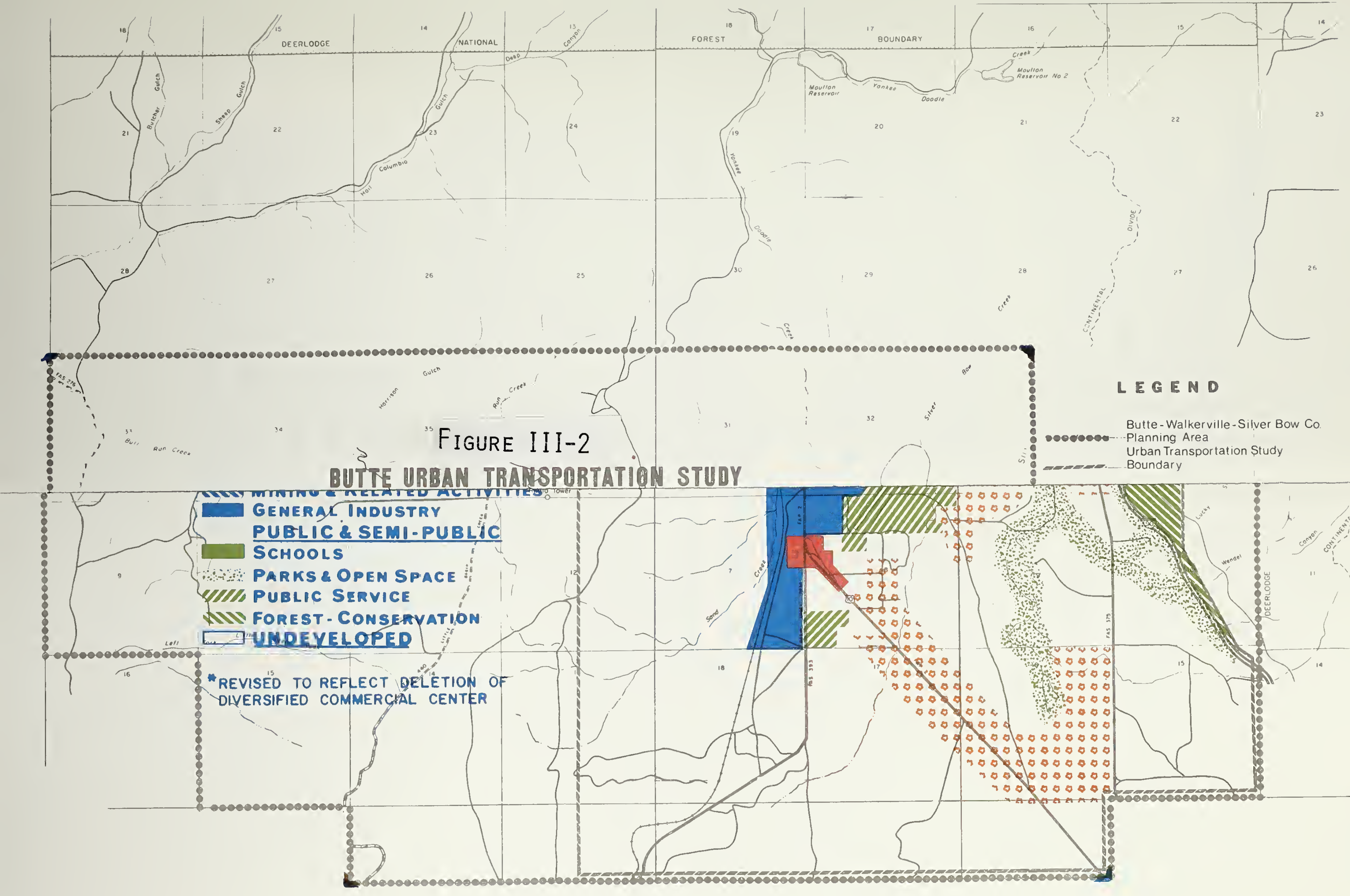


FIGURE III-2

BUTTE URBAN TRANSPORTATION STUDY

CLETE DAILY AND ASSOCIATES
HELENA, MONTANA

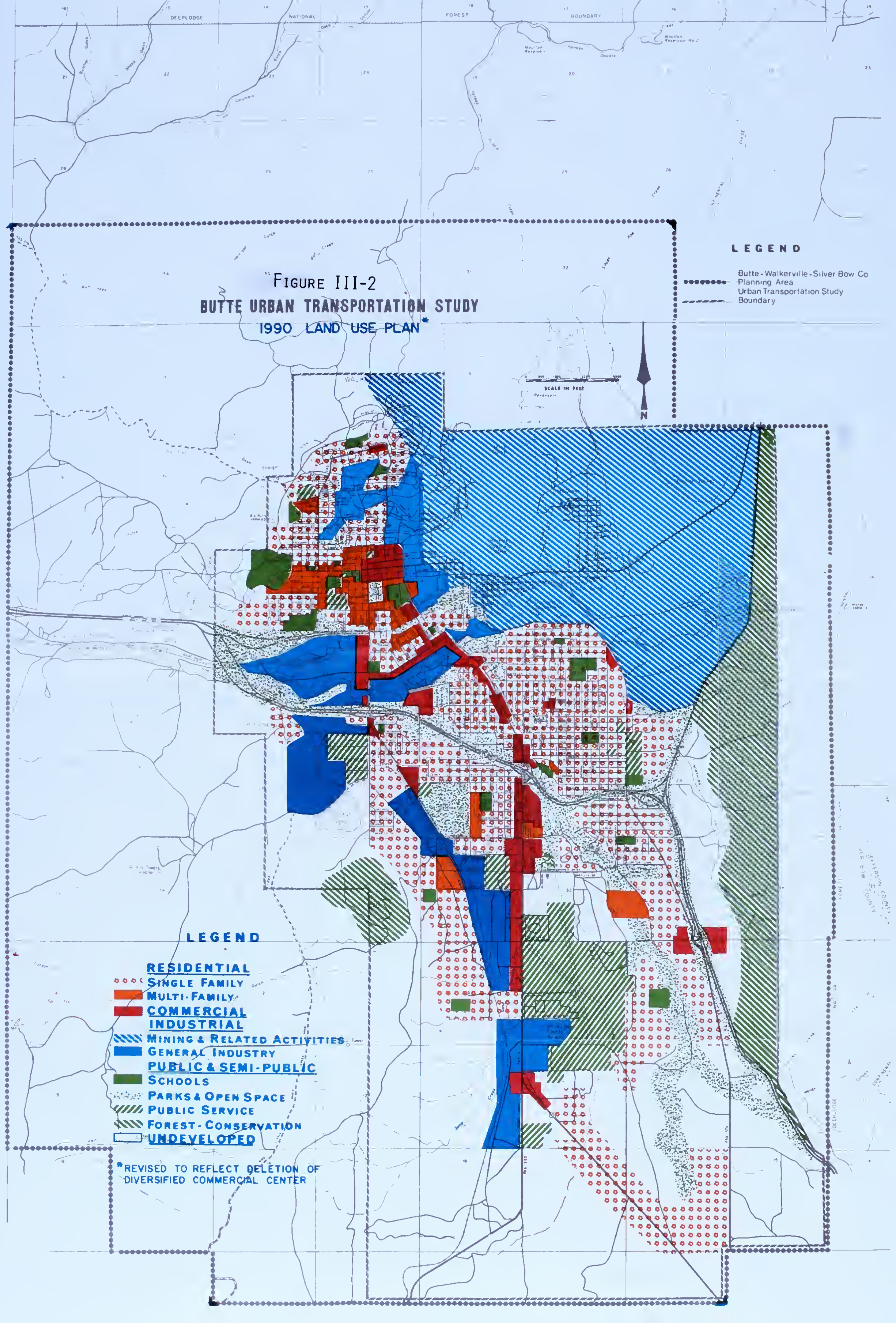


FIGURE III-2
BUTTE URBAN TRANSPORTATION STUDY
1990 LAND USE PLAN*

*REVISED TO REFLECT DELETION OF DIVERSIFIED COMMERCIAL CENTER

CLETE DAILY AND ASSOCIATES
HELENA, MONTANA

Dwelling Units

Distribution of households followed the guidelines established in the Land Use Plan Report prepared for the Butte-Silver Bow City-County Planning Board by Howard, Needles, Tammen and Bergendoff. The study area was subdivided into five (5) sectors. They are illustrated in Figure III-3.

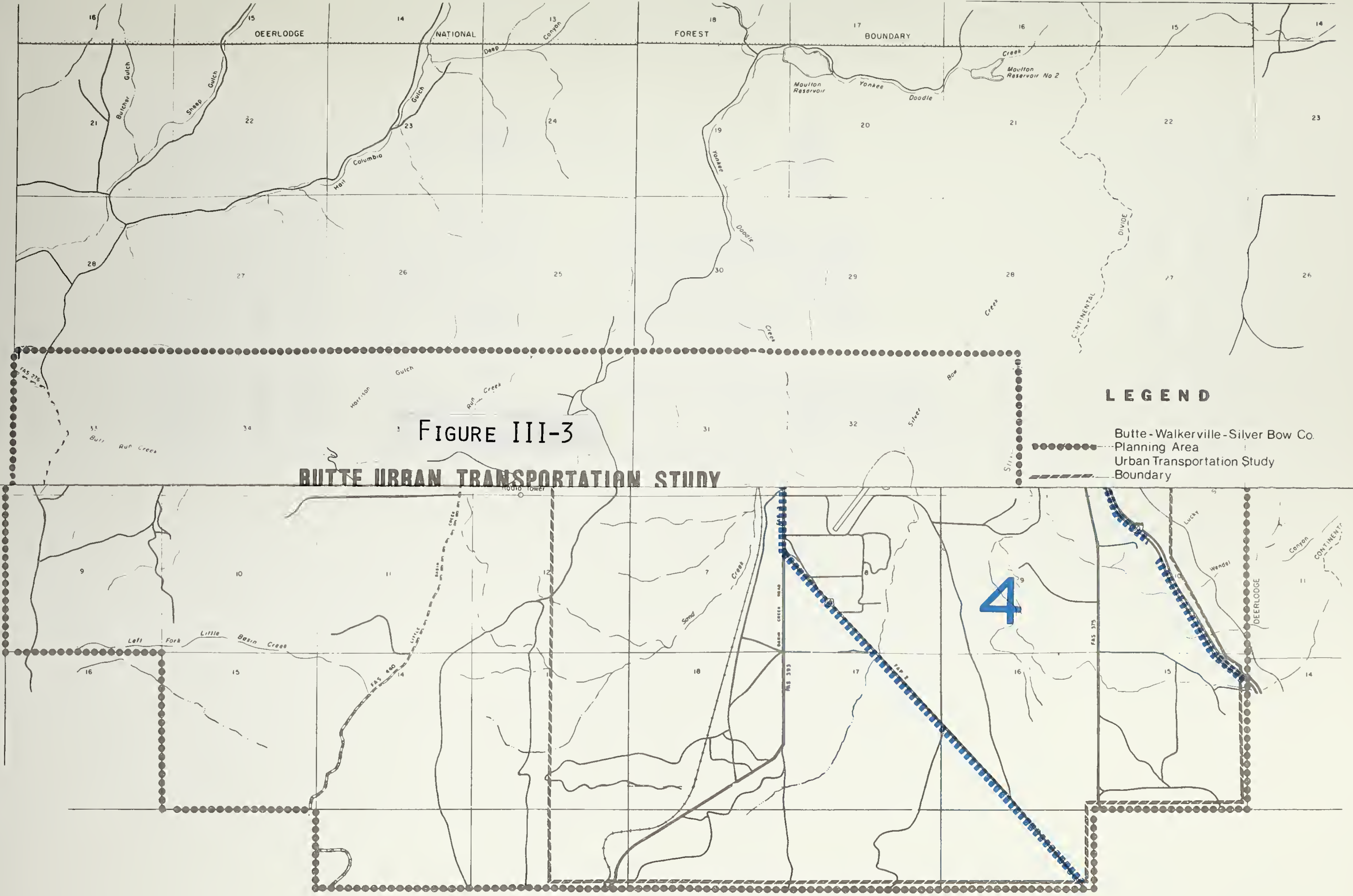
The Land Use Plan called for an increase of 2250 new occupied dwelling units to meet the needs of the new population. In order to account for vacant units, a total of 2647 households were added to the planning area. This brought the 1990 total to 17,712 with a vacancy rate of 10.0 percent.

Mining is still very active in the Butte area, and is expected to continue its areawide expansion. The result of this activity will be destruction of approximately 1900 housing units and relocation to other parts of the study area. Many of these units are old and the vacancy rate approaches 25 percent. Commercial growth is evident along many arterials, and will cause residential use to be relocated to newer areas. It is estimated that the combination of these activities will cause a decrease of 2840 units throughout the planning period, 1970-1990.

Relocation of displaced households and the expanding population will require 5487 new dwelling units. The Howard, Needles, Tammen and Bergendoff Land Use Plan Report called for 70 percent of the new housing construction to be single-family residences. However, housing costs are soaring and multi-family complexes are expanding rapidly throughout

FIGURE III-3

BUTTE URBAN TRANSPORTATION STUDY



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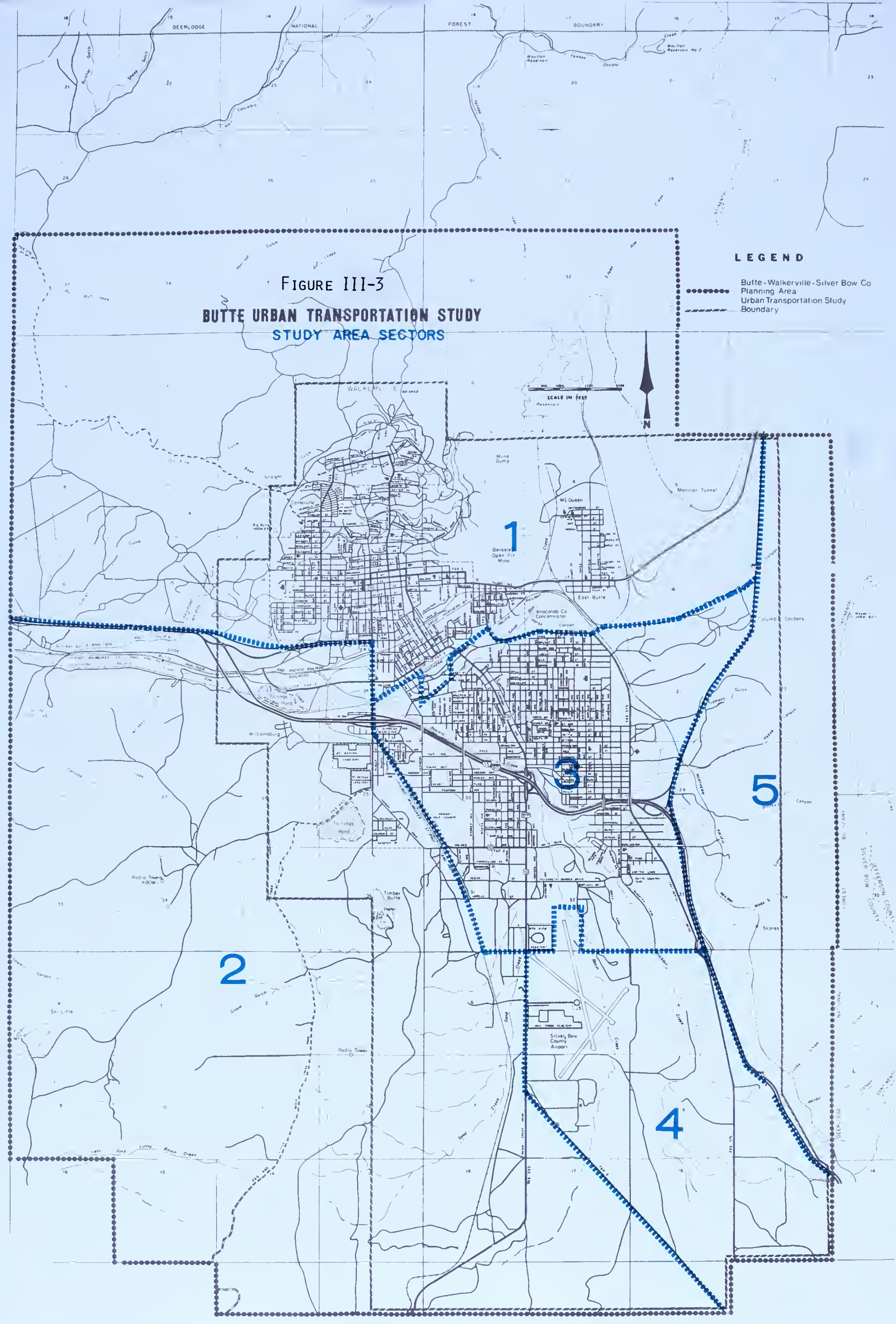

FIGURE III-3

BUTTE URBAN TRANSPORTATION STUDY

STUDY AREA SECTORS

the study area. The percent of single-family residences was reduced six (6) percent, and the resultant division was 3546 single-family and 1961 multi-family units. Table III-3 illustrates the projected dwelling unit changes by area sector.

TABLE III-3

1990 DWELLING UNIT DISTRIBUTION

Sector	Total 1970 Dwelling Units		(-) Dwelling Unit Decrease Due to Land Use Change		(+) Dwelling Unit Increase Due to Relocation and New Population		Total 1990 Dwelling Units		Change 1970-1990	
	SF	MF	SF	MF	SF	MF	SF	MF	SF	MF
1	4,950	3101	1738	937	350	1147	3,479	3394	-1471	+ 293
2	504	27	18	2	342	156	826	183	+ 322	+ 156
3	6,158	282	135	10	2703	602	8,702	894	+2548	+ 612
4	43	0	0	0	131	56	174	56	+ 131	+ 56
5	0	0	0	0	0	0	0	0	0	0
Sub-Total	11,655	3410	1891	949	3526	1961	13,185	4527	+1530	+1117
Total	15,065		2840		5487		17,712		+2647	

Distribution of the 5487 units was based on the proposed Howard, Needles Tammen and Bergendoff Land Use Plan (Plate Number 15) and densities of three (3) to five (5) dwelling units per acre and twelve (12) dwelling units per acre for single-family and multi-family households, respectively.

A 1000 scale aerial photograph, taken in August, 1972, was used to identify vacant land parcels.

The Montana Standard was monitored on a regular basis to obtain current data on proposed housing. The newspaper carried accounts of new housing projects and their planned locations. Each of the following complexes were accounted for in the distribution process:

TABLE III-4

CURRENT HOUSING PROJECTS

Project Name	Location	Number of Units
City View Mobile Estates	Rowe Road	75
Town and Country Club Apartments	South of 17th green of Butte County Club	56
Sunset Silver Bow Apartments	Farragut Avenue south of Pasley Motors	56
Eagles' Manor	Hill Avenue just east of Municipal Golf Course	160
Ridgeview Heights	South of Airport	120

The Technical Advisory Committee reviewed the dwelling unit distribution and added valuable input due to knowledge of the study area. The resulting distributions vary slightly from the plan proposed by Howard, Needles, Tammen, and Bergendoff. This occurred because of the proposed housing projects listed above, input from the Technical Advisory Committee, and in some locations the Howard, Needles, Tammen, and Bergendoff report allocated more area than the projected number of dwelling units could use.

The distribution of both single-family and multi-family households for each zone in the study area is shown in Table III-11 at the end of this chapter.

Population

Distribution of 1970 population to the respective dwelling units was found to be dependent upon location within the study area. The 1970 dwelling unit survey indicated that densities in the central business district averaged only 0.79 residents/total dwelling units and 1.09 residents/occupied dwelling units. Areas north of Front Street and outside the central business district showed densities of 2.38 persons/total dwelling units while the newer developing zones south of Front Street indicated 3.14 persons/total dwelling units.

The central business district has a number of vacant units and most of the occupied units have only one occupant. Since this is an older area, many of the units are substandard and will be removed by 1990. In 1970, there were 1001 dwelling units and by 1990 there will be only 326. The resulting density will increase to 1.15 persons/dwelling unit.

There are 45,757 residents to be distributed outside the central business district to the remaining 17,386 dwelling units. The resulting average is 2.63 persons/dwelling unit. It is assumed that by 1990 the densities will nearly equalize throughout the study area. The basis of this assumption is that the number of elderly people in Butte will begin to decline after 1980 and because of a trend toward smaller family size. Resulting densities used were 2.60 for zones north of Front Street (and

outside of the central business district) and 2.65 for the remaining zones south of Front Street.

The distribution of population to individual traffic analysis zones is shown in Table III-11 at the end of this chapter.

Employment

Table III-2 shows that the 1990 employment in the urban study area is estimated to be 16,500 persons. The division of that labor force is given in the following table.

TABLE III-5

EMPLOYMENT FORECAST BY MAJOR INDUSTRY

	1990
Agriculture, Forestry, Fisheries	100
Mining	2,250
Construction	900
Manufacturing	2,300
Transportation, Communication, Utilities	1,450
Trade	3,900
Services	3,600
Finance, Insurance, Real Estate	700
Public Administration	900
Other	400
TOTAL	16,500

Source: Population and Economic Inventory and Analysis, Howard, Needles, Tammen, and Bergendoff, p. 18-7.

Distribution of employment to traffic analysis zones was on the basis of the 1990 Land Use Plan Number 2 shown in Figure III-2. Two major categories of land use illustrated in the figure are commercial and general industry. It was necessary to determine the number of employees from the above table that fell into these two categories. General Industry contains manufacturing, transportation, communications, utilities and wholesale trade. The first four (4) of these total 3750 employees; wholesale trade was estimated as a portion of trade. Examination of past trends from the United States Census Bureau data for Silver Bow County indicate that approximately 15 percent of trade, or 585 employees will be included in wholesale trade in 1990. The resulting number of general industry employees is 4335.

Commercial employment includes the balance of trade employees (3315) and a portion of services employment. Schools and hospital employment are included in the services category, but are not considered commercial. They were forecasted and distributed individually. Primary and secondary school employment (private and public) was 795 in 1970, and is forecasted to increase slightly to 820 by 1990. The institutions of higher education, Montana College of Mineral Science and Technology (Montana Tech) and the Butte Vocational-Technical Center (Vo-Tech) had respectively, 262 and 76 employees in 1970. Trends during 1971-1972 indicate slight decreases in the number of students at the school of mining, while enrollments in the vocational school have increased. With expansion and possible relocation of the Vo-Tech Center, improvement of the Montana Tech campus, and a dynamic education program to meet needs

of upcoming students, employment at these two facilities is forecasted to double by 1990 bringing the total to 676 employees. Educational activities in Butte are forecasted to employ a total of 1496 employees in 1990.

Hospitals and nursing homes employed 845 employees in 1970. The Community Facilities Plan* states that "additional nursing homes, elderly housing, etc. may have to be provided in the future to accomodate increasing number of elderly persons". There is no mention of hospital services. Hence, it is assumed that increases in hospital services will parallel the expansion in population. Examination of the ratio of population per hospital employee for 1970 and 1990 indicates a growth of 125 hospital employees.

Silver Bow County has two homes for the "dependent population", the County Old Folks Home and Crest Rest Home. They employed 110 employees in 1970. Population characteristics were studied to determine additional needs for the next twenty years. Table III-6 examines the size of age groups 45-54 and over 45. These age groups will be entering the dependency age group during the next twenty years.

TABLE III-6

POTENTIAL DEPENDENT POPULATION

Age Group	1950	1960	1970
45-54	6,062	5,989	4,962
+ 45	15,578	15,792	14,887

---

* Community Facilities Plan, Howard, Needles, Tammen, & Bergendoff, June, 1971.

This table indicates that the dependency age group may expand slightly from 1970 to 1980, but subsequent to 1980, the demand should begin to decrease. Hence, it is assumed that the existing facilities are adequate. The County Home was constructed in 1880, and is in poor condition. Butte Park Royal, a proposed facility in zone 81, is expected to relieve the County Home. Total service employment to care for dependent senior citizens is forecasted at 120 by 1990. The resulting hospital and nursing home employment is forecast at 980.

Commercial employment was obtained as follows:

TABLE III-7

1990 COMMERCIAL EMPLOYMENT

		Commercial Employment
Trade	3900	
Less Wholesale Trade	585	
Subtotal		3315
Services	3600	
Less Hospital employment	980	
Less School employment	1496	
Subtotal		1124
Finances, Insurance, Real Estate	700	
Subtotal		700
TOTAL		5139

Public administration employment includes the United States Postal Service and federal, state, and local government administrations. Employment for 1970 was found to be 598, with estimated expansion to 900 employees by 1990.

Table III-5 includes 400 employees under the "Other" classification. Employment distributed in accordance with this category included domestics, (i.e. hotels and motels), some recreation, parks, and playgrounds, and divisions of federal, state, and local government not previously covered under public administration.

Table III-8 lists the number of employees distributed to each traffic analysis zone. The distributions parallel existing densities and correlate with Land Use Plan Number 2, illustrated in Figure III-2. These zonal totals were entered into the trip generation equations in order to generate 1990 travel. This is covered in the next chapter.

Other Social-Economic Variables

The trip generation analyses explained in Tech Plan Number 2 determined that five additional variables correlated well with trip making in the Butte study area. They include the following:

1. Number of persons age five (5) and over/zone.
2. Number of Cars and pickups/zone.
3. Number of Trucks/zone.
4. Number of Employees at each residence/zone.
5. Floor space in square feet/zone.

TABLE III-8

1990 EMPLOYMENT BY TYPE AND ZONE

Zone	Public Administration	Schools	Hospitals	Mining	General Industry	Commercial	Construction and Agriculture	Other	1990 Totals
1	231	0	0	0	0	0	44	0	275
2	0	0	0	0	131	89	3	0	223
3	0	0	0	0	0	7	2	0	9
4	0	0	0	0	0	2	2	0	4
5	0	0	0	0	0	6	2	20	28
6	0	0	0	0	0	5	2	0	7
7	0	0	0	35	0	112	2	0	149
8	15	0	0	0	6	224	2	14	261
9	0	0	0	0	102	75	3	0	180
10	46	0	0	0	0	0	4	2	52
11	0	0	0	0	145	11	3	0	159
12	0	0	0	0	0	126	3	0	129
13	0	0	0	0	0	164	3	0	167
14	145	0	0	0	302	527	13	120	987
15	0	0	0	0	0	10	2	0	132
16	0	0	0	0	0	10	2	0	12
17	0	0	0	0	6	412	3	0	421
18	0	0	0	0	8	41	3	0	52
19	0	0	0	0	0	48	3	0	51
20	0	32	0	0	0	0	3	0	35
21	0	0	0	0	0	0	3	0	3
22	0	0	0	0	0	11	3	0	14
23	0	0	0	0	0	48	2	0	50
C.B.D. Sub-Total	437	32	0	35	700	1,928	112	156	3,400

TABLE III-8 (continued)

1990 EMPLOYMENT BY TYPE AND ZONE

Zone	Public Administration	Schools	Hospitals	Mining	General Industry	Commercial	Construction and Agriculture	Other	1990 Totals
24	0	0	0	0	25	0	3	0	28
25	0	0	0	50	0	0	0	0	50
26	0	0	0	0	15	0	3	0	18
27	185	0	0	0	20	0	23	0	228
28	0	0	0	0	0	35	0	0	35
29	0	0	0	0	20	0	3	0	23
30	0	0	0	384	20	0	3	0	407
31	0	0	0	0	0	0	0	0	0
32	0	12	0	0	0	12	3	0	27
33	0	0	0	0	0	0	0	0	0
34	0	14	0	0	0	0	3	0	17
35	0	0	0	0	0	0	3	0	3
36	0	0	0	0	20	0	6	0	26
37	0	0	0	0	0	0	6	0	6
38	0	548	0	0	0	0	24	0	572
39	0	9	0	0	0	72	12	5	98
40	0	0	0	0	0	0	3	0	3
41	49	72	0	0	0	110	12	5	248
42	0	0	0	0	0	0	0	0	0
43	0	78	510	0	0	0	9	0	597
44	0	0	33	0	0	0	6	0	39
45	0	0	0	0	0	0	3	0	0
46	0	287	0	0	0	34	9	0	330
47	0	0	0	0	0	0	3	0	3
48	3	0	0	0	20	132	6	0	161
49	0	0	0	0	58	0	6	0	64
50	0	0	0	60	0	0	0	0	60
51	0	0	0	604	0	0	0	0	604

TABLE III-8 (continued)

1990 EMPLOYMENT BY TYPE AND ZONE

Zone	Public Administration	Schools	Hospitals	Mining	General Industry	Commercial	Construction and Agriculture	Other	1990 Totals
52	0	0	0	384	0	0	0	0	384
53	0	0	0	234	0	0	0	0	234
54	0	0	0	100	0	0	0	0	100
55	0	0	0	299	0	0	0	0	299
56	0	0	0	0	54	0	9	0	63
57	0	0	0	0	0	90	6	2	98
58	0	0	0	0	0	65	9	4	78
59	0	0	0	0	90	41	12	0	143
60	0	0	0	0	130	80	12	28	250
61	0	44	0	0	40	0	12	0	96
62	0	0	0	0	43	213	6	0	262
63	0	14	0	0	10	86	6	0	116
64	0	0	0	0	100	63	6	0	169
65	195	0	0	0	0	100	26	0	321
66	0	0	0	0	0	182	12	0	194
67	0	0	0	0	64	41	6	67	178
68	0	0	0	0	0	0	6	0	6
69	0	21	0	0	0	0	9	0	30
70	0	0	0	100	0	0	0	0	100
71	0	126	0	0	0	0	9	0	135
72	0	0	0	0	0	4	6	0	10
73	0	0	0	0	0	83	9	0	92
74	0	40	0	0	0	115	9	0	164
75	0	0	0	0	0	92	18	0	110
76	0	0	0	0	84	32	21	0	137
77	0	0	0	0	0	0	12	0	12
78	0	0	0	0	0	75	12	0	87
79	0	0	0	0	0	180	12	0	192
			0						

TABLE III-8 (continued)

1990 EMPLOYMENT BY TYPE AND ZONE

Zone	Public Administration	Schools	Hospitals	Mining	General Industry	Commercial	Construction and Agriculture	Other	1990 Totals
80	0	0	0	0	0	4	6	0	10
81	0	0	42	0	0	0	6	0	48
82	0	0	317	0	0	10	18	0	345
83	0	34	58	0	0	0	12	0	104
84	0	0	0	0	0	77	15	0	92
85	0	0	0	0	0	49	15	0	64
86	0	0	0	0	0	20	9	53	82
87	0	0	0	0	0	0	9	0	9
88	0	38	20	0	0	0	12	0	70
89	0	0	0	0	0	0	6	0	6
90	0	0	0	0	0	0	6	0	6
91	0	28	0	0	0	0	6	0	34
92	0	0	0	0	0	220	36	10	266
93	0	0	0	0	0	129	32	6	167
94	0	29	0	0	0	125	24	16	194
95	0	0	0	0	0	0	6	0	6
96	0	0	0	0	0	0	6	0	6
97	0	18	0	0	16	46	21	0	101
98	0	0	0	0	178	20	12	0	210
99	0	0	0	0	19	0	12	0	31
100	1	0	0	0	62	0	12	0	75
101	0	0	0	0	72	0	6	10	88
102	0	0	0	0	0	374	33	20	427
103	30	20	0	0	189	50	33	0	322
104	0	0	0	0	0	0	0	0	0
105	0	0	0	0	0	10	12	18	40
106	0	15	0	0	0	10	12	0	37
107	0	0	0	0	129	0	21	0	150

TABLE III-8 (continued)

1990 EMPLOYMENT BY TYPE AND ZONE

Zone	Public Administration	Schools	Hospitals	Mining	General Industry	Commercial	Construction and Agriculture	Other	1990 Totals
108	0	17	0	0	157	80	30	0	284
109	0	0	0	0	2,000	0	45	0	2,045
110	0	0	0	0	0	5	3	0	8
111	0	0	0	0	0	25	6	0	31
112	0	0	0	0	0	0	6	0	6
113	0	0	0	0	0	0	3	0	3
114	0	0	0	0	0	20	3	0	23
115	0	0	0	0	0	0	0	0	0
TOTAL	900	1,496	980	2,250	4,335	5,139	1,000	400	16,500

1. Number of Persons Age Five (5) and Over

Each of these variables was forecasted for 1990 and distributed to the analysis zones. The number of persons age five and over was taken as 93 percent of the zone population for all areas outside the central business district and 97 percent for the twenty-three (23) central business district zones. The basis of these percentages was the 1970 dwelling unit survey and trends in the population reported by the United States Census Bureau, 1950-1960 and 1960-1970.

2. Number of Cars and Pickups

The number of vehicles per dwelling unit was also found to be dependent upon location within the metropolitan area. The study area was divided into four areas and average ratios varied from 0.33 to 1.547. To obtain 1990 ratios of vehicles/dwelling units, a projection of vehicle registration was examined in the Major Thoroughfare Plan prepared by Howard, Needles, Tammen, and Bergendoff. That report projects a 22.8 percent increase in registration compared to 17.5 percent for total dwelling units. The increase of 5.3% was applied to the 1970 ratios. The resulting zonal distributions are given in Table III-11.

3. Number of Trucks

There were 888 trucks in the Butte transportation study area during 1970. This represents only 3.9% of the total vehicle registration. These trucks were associated with commercial uses, general industry, construction, mining, and other city and state maintenance.

Accurate projection of this small number of trucks is difficult

because statistics are not reliable with such a small sample. The Port of Butte alone is projected to have 300 trucks operating by 1990. This represents a 33.7 percent increase in the number of trucks. Each of the other employment categories, with the exception of mining, is forecasted to show considerable growth.

By 1990, trucks are expected to represent a greater percentage of the vehicle registration. With the large increase in the Port of Butte, total trucks in 1990 are forecasted to represent 6.1 percent of the 29,000 registered vehicles. Distribution of these 1776 trucks was assumed to be proportional to employment per zone. The number of trucks per zone is illustrated in Table III-11.

4. Number of Employees At Each Residence

In 1970, 41.3 percent of the people living in the central business district were employed, and in the remaining areas 34.2 percent of the residents held jobs. These percentages were altered slightly to obtain the number of employees residing at each dwelling unit in 1990. Table III-2 indicated that employment is expected to increase by 22.3 percent while population expands 17 percent. Hence, the 1970 percentage of people employed were increased by five (5) percent. A second factor was applied. The Butte-Silver Bow City-County Planning Board estimates that in 1990 there will be 200-300 persons residing in Butte but working outside the study area at Stauffer Chemical or in the City of Anaconda. This imbalance was accounted for by increasing the number of employees by one percent. Total 1990 employees was found to be 16,742 and they were distributed to zones as follows:

TABLE III-9

DISTRIBUTION OF 1990 EMPLOYEES

Area	Factor (F)
Central Business District Zones 1-23	(0.413)(1.05)(1.01) = 0.4380
Outside Central Business District Zones 24-115	(0.342)(1.05)(1.01) = 0.3627

The factors listed in Table III-10 were multiplied by the population per zone to obtain the number of employees residing in that zone.

5. Floor Space in Square Feet

1970 floor space was obtained from the land use inventory tape prepared for the Butte-Silver Bow Comprehensive Plan. That tape is described in Tech Plan Report Number 2. Total space was listed at 10,098,638 square feet, and the ratio of square feet per employee was obtained for each zone by major employment type. A separate set of ratios were determined for the central business district and the remaining areas. This was done because of higher densities in the central business district. Utilizing these ratios with 1990 employment, forecasted floor space was obtained.

1990 floor space is shown in the following table:

TABLE III-10

1990 FLOOR SPACE (SQUARE FEET)

Land Use Type \ Area	Central Business District Zones 1-23	Remaining Areas Zones 24-115	Total
Commercial #5, 6	1,869,425	6,710,400	8,579,825
General Industry #2, 3, 4,	354,200	6,962,000	7,316,200
Cultural #7	90,000	555,896	645,896
Subtotal	2,313,625	14,228,296	16,541,921
Mining #8	17,500	210,800	228,300
Vacant #9	163,197	1,010,611	1,173,808
Total	2,494,322	15,449,707	17,944,029

A tabulation of each of the trip generation variable is shown in Table III-11. These variables were used in the trip generation equations to obtain 1990 travel as described in Chapter IV.

TABLE III-11

1990 TRIP GENERATION VARIABLES BY ZONE

Zone	Total Dwelling Units (occupied + vacant) Single Family	Total Dwelling Units (occupied + vacant) Multi-Family	Total Dwelling Units (occupied + vacant) Total	Population	No. of Persons 5 & over	Employees	Employment	Vehicles (Cars + Pickups)	No. of Trucks	Floor* Space (sq. ft.)
1	0	10	10	11	11	5	275	3	10	190,190
2	0	29	29	34	33	15	223	10	37	132,066
3	0	0	0	0	0	0	9	0	0	6,435
4	0	0	0	0	0	0	4	0	0	2,860
5	0	0	0	0	0	0	28	0	2	20,020
6	0	0	0	0	0	0	7	0	0	5,005
7	0	0	0	0	0	0	149	0	7	81,510
8	0	23	23	26	25	11	261	8	20	185,361
9	0	19	19	22	21	10	180	6	30	107,382
10	0	35	35	41	40	18	52	12	32	55,980
11	0	45	45	52	50	23	159	16	35	95,645
12	0	24	24	28	27	12	129	8	8	97,240
13	0	13	13	14	14	6	167	4	11	115,695
14	0	0	0	0	0	0	987	0	85	642,287
15	0	0	0	0	0	0	132	0	8	94,380
16	0	0	0	0	0	0	12	0	1	8,580
17	0	84	84	98	95	43	421	30	30	299,761
18	0	0	0	0	0	0	52	0	7	35,508
19	0	0	0	0	0	0	51	0	3	50,090
20	0	0	0	0	0	0	35	0	2	39,725
21	0	11	11	12	12	5	3	3	0	2,145
22	0	0	0	0	0	0	14	0	1	10,010
23	0	33	33	38	37	17	50	11	3	35,750
C.B.D. Sub-Total	0	326	326	376	365	165	3,400	111	332	2,313,625

TABLE III-11 (continued)

1990 TRIP GENERATION VARIABLES BY ZONE

Zone	Total Dwelling Units (occupied + vacant) Single Family	Multi-Family	Total	Population	No. of Persons 5 & over	Employees	Employment	Vehicles (Cars + Pickups)	No. of Trucks	Floor* Space (sq. ft.)
24	0	0	0	0	0	0	28	0	8	32,796
25	0	0	0	0	0	0	50	0	1	0
26	0	0	0	0	0	0	18	0	6	20,796
27	0	0	0	0	0	0	228	0	23	217,856
28	46	63	109	284	264	102	35	117	2	32,620
29	100	6	106	277	258	100	23	114	7	26,796
30	188	0	188	490	456	178	407	203	15	26,796
31	163	33	196	511	475	185	0	211	8	0
32	133	5	138	359	335	131	27	149	2	28,693
33	90	5	95	247	230	89	0	102	0	0
34	174	94	268	697	648	252	17	376	1	15,844
35	384	94	478	1,242	1,154	450	3	669	0	12,916
36	185	143	328	854	794	309	26	355	0	29,592
37	92	0	92	239	222	86	6	129	3	5,592
38	51	269	320	832	774	301	572	448	42	745,734
39	285	317	602	1,564	1,454	566	98	650	14	173,589
40	51	161	212	550	512	199	3	297	0	2,796
41	144	425	569	1,477	1,373	535	248	614	23	231,136
42	17	31	48	122	113	44	0	52	0	0
43	446	102	548	1,426	1,326	516	597	767	40	599,561
44	102	281	383	998	928	362	39	414	47	36,348
45	102	371	473	1,232	1,146	446	3	511	0	2,796
46	92	29	121	314	292	113	330	130	25	155,412
47	0	205	205	532	495	193	3	222	0	75,192
48	0	0	0	0	0	0	161	0	17	0
49	0	0	0	0	0	0	64	0	16	0
50	0	0	0	0	0	0	60	0	2	0

TABLE III-11 (continued)

1990 TRIP GENERATION VARIABLES BY ZONE

Zone	Total Dwelling Units (occupied + vacant) Single Family	Multi-Family	Total	Population	No. of Persons 5 & over	Employees	Employment	Vehicles (Cars + Pickups)	No. of Trucks	Floor* Space (sq. ft.)
51	0	0	0	0	0	0	604	0	13	0
52	0	0	0	0	0	0	384	0	9	0
53	0	0	0	0	0	0	234	0	5	0
54	0	0	0	0	0	0	100	0	3	0
55	0	0	0	0	0	0	299	0	7	0
56	158	20	178	463	431	168	63	192	16	73,188
57	102	267	369	961	894	349	98	399	9	91,336
58	87	37	124	322	299	116	78	134	8	72,696
59	72	0	72	190	177	68	143	117	28	157,396
60	10	0	10	27	25	10	250	16	41	267,840
61	72	7	79	205	191	74	96	128	13	100,192
62	153	81	234	609	566	221	262	253	27	256,846
63	62	22	84	216	201	78	116	90	11	110,792
64	61	5	66	174	162	63	169	107	29	184,308
65	0	0	0	0	0	0	321	0	28	299,172
66	164	139	303	808	752	293	194	496	17	180,808
67	370	78	448	1,188	1,104	431	178	730	24	222,885
68	327	19	346	913	850	332	6	564	3	5,592
69	381	11	392	1,038	966	377	30	639	5	27,960
70	91	0	91	241	224	87	100	148	2	0
71	501	6	507	1,344	1,249	487	135	826	12	125,820
72	409	11	420	1,114	1,036	404	10	685	3	9,320
73	159	5	164	434	404	157	92	268	9	85,744
74	174	10	184	488	454	177	164	300	14	155,398
75	158	10	168	447	416	162	110	274	12	102,520
76	0	3	3	8	7	3	137	5	27	150,196
77	215	0	215	569	529	206	12	350	5	11,184

TABLE III-11 (continued)

1990 TRIP GENERATION VARIABLES BY ZONE

Zone	Total Dwelling Units (occupied + vacant) Single Family	Multi-Family	Total	Population	No. of Persons 5 & over	Employees	Employment	Vehicles (Cars + Pickups)	No. of Trucks	Floor* Space (sq. ft.)
78	349	15	364	962	895	349	87	594	10	81,084
79	286	11	297	789	734	286	192	484	17	178,944
80	296	11	307	816	759	295	10	501	3	96,605
81	235	5	240	636	593	231	48	391	3	44,736
82	316	5	321	851	792	308	345	523	27	321,540
83	409	6	415	1,100	1,023	399	104	677	11	96,928
84	376	6	382	1,014	943	368	92	623	10	85,744
85	148	0	148	393	366	143	64	241	8	59,648
86	92	45	137	363	339	132	82	223	5	76,424
87	230	0	230	609	566	221	9	375	4	8,388
88	159	0	159	420	391	152	70	260	11	65,240
89	343	0	343	907	844	328	6	559	3	5,592
90	430	0	430	1,138	1,059	413	6	701	3	5,592
91	271	0	271	718	668	260	34	442	5	31,688
92	72	0	72	190	177	68	266	117	24	247,912
93	220	276	496	1,314	1,221	476	167	808	18	155,644
94	337	15	352	936	871	340	194	573	18	185,235
95	179	6	185	491	457	178	6	302	3	5,592
96	309	0	309	818	761	296	6	503	3	5,592
97	235	31	266	705	656	255	101	434	14	98,420
98	79	0	79	209	75	75	210	128	44	243,424
99	10	5	15	40	14	14	31	24	9	33,984
100	94	108	202	537	195	195	75	330	18	86,516
101	98	174	272	721	261	261	88	443	20	103,042
102	266	51	317	840	304	304	427	516	34	397,964
103	63	0	63	168	61	61	322	103	59	350,756
104	0	0	0	0	0	0	0	0	0	0

TABLE III-11 (continued)

1990 TRIP GENERATION VARIABLES BY ZONE

Zone	Total Dwelling Units (occupied + vacant)			Population	No. of Persons 5 & over	Employees	Employment	Vehicles (Cars + Pickups)	No. of Trucks	Floor* Space (sq. ft.)
	Single Family	Multi-Family	Total							
105	414	0	414	1,097	1,020	398	40	675	7	57,920
106	55	57	112	298	280	108	37	182	7	34,484
107	18	0	18	49	45	18	150	29	35	174,372
108	71	10	81	217	202	78	284	132	48	306,764
109	0	0	0	0	0	0	2,045	0	300	5,041,940
110	51	0	51	135	126	49	8	83	0	7,456
111	41	0	41	108	100	39	31	67	5	28,892
112	51	0	51	135	125	49	6	83	3	5,592
113	10	0	10	27	25	10	3	16	0	2,796
114	0	0	0	0	0	0	23	0	1	21,436
115	0	0	0	0	0	0	0	0	0	0
TOTAL	13,184	4,528	17,712	46,133	42,928	16,742	16,500	25,504	1,804	16,541,921

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* Floor Space includes Land Use Categories #2 through #7.

CHAPTER IV

1990

PRODUCTIONS AND ATTRACTIONS

1990

PRODUCTIONS AND ATTRACTIONS

A set of trip generation equations was developed using stepwise multiple linear regression techniques. Procedures and the resulting equations were presented in Tech Plan Report Number 2, "1970 Traffic Assignment, Trip Generation, Gravity Model Calibration". Social-economic variables found to correlate well with trip making in the Butte area that were used in the regression equations are listed in Table VI-1:

TABLE IV-1

TRIP GENERATION VARIABLES

Total Dwelling Units
Persons Age Five (5) and Over
Persons Employed at Work Location
Employees at Place of Residence
Trucks
Cars + Pickups
Floor Space (Land Use Categories #2 through #7)

The 1990 trips were predicted by projecting values of the above variables. Forecasting techniques and the results are shown in Chapter III of this report. Using the assumption that the trip generation equations will be relatively stable during the planning period, the forecasted social-economic values were input to the regression equations to generate 1990 productions and attractions. Following generation of the

future productions and attractions, each zone was examined to determine the reasonableness of the forecasted trips. In a few cases productions and attractions were adjusted to account for factors not accounted for by the trip generation equations. This chapter presents the resulting productions and attractions by trip type for each zone, that were input to the gravity model for distribution.

During development of the regression equations, statistical validity was checked using ten districts, each comprised of a group of zones with similar characteristics. It was possible for a district to be statistically accurate (between the predicted and actual 1970 productions and attractions), yet the number of trips predicted for a particular zone may be somewhat high or low. The consultant found that for some of the zones in the older developed areas, the equations tended to overpredict while the opposite was true of zones in newer developed zones. It was assumed that if the equation underpredicted for 1970, and that same zone's characteristics did not change materially through the planning period, the equation would also underpredict for 1990. Using this assumption a few zones were adjusted upward. Since there has been a national trend toward increased travel (especially in smaller urban areas), none of the predicted productions and attractions were reduced.

It is important to emphasize that the trip generation equations were not adjusted. The "best" equations were used to predict trips, followed by an in depth examination of the resulting productions and attractions for each zone by trip type. In this way the best least squares fit was maintained.

Traffic analysis zones that exhibited unusual characteristics and did not satisfy the statistical requirements of the regression equations during regression tests were referred to as "special zones". They were presented in Tech Plan Report Number 2. Prediction of 1990 productions and attrations for the special zones was based on forecasted employment and floor space, and general location within the metropolitan area. Growth factor techniques were used to estimate productions and attractions for these areas.

The resulting 1990 trip productions and attractions per zone are shown in Table IV-2.

TABLE IV-2

1990 PRODUCTIONS AND ATTRACTIONS

Zone	HBW, P	HBW, A	HBO, P	HBO, A	NHB, P & A	Int.-Ext. P & A	Truck, P & A	Taxi, P & A
1	6	227	20	589	370	34	21	8
2	18	191	61	482	301	42	43	11
3	0	44	0	47	13	14	7	6
4	0	40	0	9	5	14	7	6
5	0	57	0	59	38	15	8	6
6	0	42	0	15	9	14	7	6
7	0	140	0	1,136	181	24	15	6
8	13	218	46	584	366	34	29	10
9	12	162	39	384	241	44	36	9
10	21	44	73	182	111	22	34	12
11	27	147	92	380	236	30	40	13
12	14	127	49	281	196	25	16	10
13	7	153	25	368	231	29	19	8
14	0	718	0	2,018	1,270	81	102	6
15	0	129	0	280	177	42	15	6
16	0	46	0	56	17	17	7	6
17	51	328	174	1,009	628	66	41	19
18	0	73	0	360	68	20	13	6
19	0	73	0	252	78	20	10	6
20	0	62	0	300	57	16	8	6
21	6	40	22	23	14	15	7	8
22	0	47	0	30	19	15	7	6

TABLE IV-2 (continued)

1990 PRODUCTIONS AND ATTRACTIONS

Zone	HBW, P	HBW, A	HBO, P	HBO, A	NHB, P & A	Int.-Ext. P & A	Truck, P & A	Taxi, P & A
23	20	72	68	153	94	34	9	11
24	0	57	0	74	37	37	34	6
25	0	72	0	65	33	17	20	6
26	0	50	0	47	24	18	30	6
27	0	332	0	546	272	29	81	6
28	112	62	493	238	112	18	21	15
29	110	53	413	211	99	28	32	15
30	196	541	731	825	400	38	73	21
31	204	38	330	279	126	39	33	22
32	144	56	537	264	122	34	20	17
33	98	38	368	135	61	25	17	14
34	277	49	1,038	421	191	49	18	19
35	646	40	1,850	698	314	76	17	29
36	340	55	1,272	533	244	57	18	33
37	138	42	355	145	67	25	21	10
38	331	641	2,304	2,250	1,001	107	90	42
39	623	179	2,330	1,181	547	108	52	56
40	219	40	820	308	139	47	17	16
41	589	209	2,201	1,395	656	104	81	53
42	49	38	182	68	31	35	17	10
43	568	449	2,611	2,240	1,079	128	140	32
44	398	109	1,488	637	290	71	123	37
45	491	4	1,836	678	305	90	17	45
46	124	451	467	3,350	900	52	91	16
47	212	40	794	298	134	40	17	23
48	0	149	0	387	193	25	62	6
49	0	139	0	169	84	28	55	6
50	0	184	0	78	39	18	23	6
51	0	454	0	49	392	87	97	6
52	0	302	0	497	249	40	44	6
53	0	199	0	303	152	30	13	6
54	0	106	0	130	65	20	27	6
55	0	583	0	92	194	34	95	6
56	185	138	691	419	197	44	55	21
57	384	110	1,433	756	351	70	41	36
58	128	91	578	360	171	45	37	16
59	75	615	282	469	401	32	86	8
60	11	210	40	646	321	70	121	6
61	81	104	529	935	300	59	50	8
62	243	371	908	1,258	819	72	91	25
63	86	201	322	535	336	32	47	13
64	69	326	259	525	258	33	90	7
65	0	360	0	2,352	1,292	35	97	6
66	322	388	1,203	892	743	76	65	13

TABLE IV-2 (continued)

1990 PRODUCTIONS AND ATTRACTIONS

Zone	HBW, P	HBW, A	HBO, P	HBO, A	NHB, P & A	Int.-Ext. P & A	Truck, P & A	Taxi, P & A
67	473	272	2,049	1,122	529	105	80	16
68	365	42	1,577	505	228	58	22	14
69	414	99	1,792	628	288	72	27	15
70	96	200	358	259	124	48	25	8
71	535	131	2,317	1,431	483	88	40	18
72	444	44	1,922	620	280	68	22	16
73	173	172	749	1,312	713	44	41	10
74	194	151	727	826	689	59	56	10
75	178	220	665	499	237	43	49	10
76	3	90	12	354	176	23	84	6
77	226	46	1,072	333	151	42	26	11
78	383	174	1,433	723	587	72	42	14
79	314	170	1,361	1,130	729	68	65	13
80	324	44	1,406	560	259	54	22	13
81	254	71	1,100	454	210	54	24	11
82	338	469	2,127	1,057	613	88	96	13
83	438	109	1,897	835	388	74	31	15
84	404	101	1,749	2,524	617	242	43	15
85	157	142	866	361	298	121	36	9
86	145	160	628	388	322	40	31	9
87	243	44	1,050	348	157	44	24	11
88	167	86	625	392	185	39	43	9
89	360	42	1,350	509	226	58	22	14
90	454	42	1,964	624	282	69	22	16
91	286	61	1,238	466	213	51	28	12
92	75	730	444	10,506	2,423	810	213	8
93	523	153	2,677	1,100	901	115	65	17
94	373	171	1,551	1,913	801	389	67	14
95	196	42	1,105	277	126	51	22	10
96	325	42	1,217	453	205	54	22	13
97	280	148	1,049	622	292	47	52	12
98	82	182	310	664	326	112	126	8
99	15	59	112	101	49	18	36	6
100	214	89	799	484	227	48	59	10
101	287	98	1,977	619	290	65	65	12
102	334	479	1,834	1,461	707	93	117	13
103	67	442	251	1,761	450	59	167	7
104	0	38	0	0	0	14	17	0
105	437	65	1,633	706	324	69	33	15
106	119	63	466	247	116	30	33	8
107	20	168	72	492	244	32	102	32
108	86	313	322	836	411	59	140	8
109	0	1,449	0	2,600	1,256	153	300	6
110	54	43	201	92	42	20	17	7

TABLE IV-2 (continued)

1990 PRODUCTIONS AND ATTRACTIONS

Zone	HBW, P	HBW, A	HBO, P	HBO, A	NHB, P & A	Int.-Ext. P & A	Truck, P & A	Taxi, P & A
111	43	59	160	132	63	21	14	7
112	54	42	200	87	40	20	21	7
113	11	40	40	21	10	15	17	6
114	0	53	0	55	27	15	18	6
115	0	38	0	0	0	14	17	6
Sub-Total	18,238	20,043	77,768	80,224	36,775	6,836	5,518	1,493
116	0	0	0	0	0	871	0	0
117	0	0	0	0	0	86	0	0
118	0	0	0	0	0	3,700	0	0
119	0	0	0	0	0	88	0	0
120	0	0	0	0	0	50	0	0
121	0	0	0	0	0	192	0	0
122	0	0	0	0	0	610	0	0
123	0	0	0	0	0	1,390	0	0
Sub-Total	0	0	0	0	0	6,987	0	0
TOTAL	18,238	20,043	77,768	80,224	36,775	13,823	5,518	1,493

CHAPTER V

EXISTING PLUS COMMITTED HIGHWAY NETWORK

EXISTING PLUS COMMITTED HIGHWAY NETWORK

The first highway network coded for the Butte urban area reflected transportation characteristics as they existed during 1970. This was necessary because the travel surveys were conducted during 1970, and it was desirable to have travel correlated with the physical network existing at that same time. The 1970 trip table was assigned to the network and link travel time adjustments were made until assigned volumes closely matched ground counts. This process is referred to as calibration of the base year network and was fully described and documented in Tech Plan Report Number 2, "1970 Traffic Assignment, Trip Generation, Gravity Model Calibration". Following calibration, the 1970 network was updated to include all construction completed between 1970-1972 and projects definitely programmed in the near future. The resulting road system is the existing plus committed highway network.

Updating the 1970 network to the existing plus committed network required input from both local and state agencies. The Technical Advisory Committee was briefed on requirements for the existing plus committed system. Agencies contacted were:

- Montana Department of Highways, Planning Survey Section
- City of Butte
- Butte Model City Agency
- Silver Bow County Surveyor's Office
- Butte-Silver Bow City-County Planning Board

The Department of Highways supplied additional information on the Berkley Pit By-Pass (an existing project since 1971) and also presented a list of committed highway projects from the five year improvement program. Committed projects are tabulated in Table V-1.

TABLE V-1

COMMITTED HIGHWAY PROJECTS

Location	Section	Length (miles)	Description	Proposed Construction Date
Grand Avenue	Harrison Avenue - Continental Drive	1.4	Reconstruct two lanes and install curb and gutters	October, 1976
Harrison Avenue	I90 & I15 - FAS 393	2.2	Reconstruct to four lanes	July, 1976

Two other projects were being considered for inclusion in the above list. They include minor widening and traffic improvements to Harrison Avenue from Olympia Street to George Street and widening of Park Street to four (4) traffic lanes. The Montana Department of Highways and the Federal Highway Administration were waiting for preliminary results of this transportation study to determine if these routes would continue to serve as major arterials in the future.

Existing plus committed projects obtained from the other agencies were located mostly on non-network streets and could be considered primarily as maintenance. They had no effect on the 1970 network.

The Model City Agency included a list of street sections that were being overlayed with two (2) to three (3) inches of asphalt between

1970 and September, 1972. These roadways have other characteristics (besides pavement condition) that control the average travel speed. Stop signs, traffic signals, school zones, and neighborhood shopping centers tend to restrict speeds. Thus, travel speeds were not altered along the streets that received overlays.

In addition to the existing plus committed projects, most agencies included valuable comments regarding improvements they felt should be considered during the transportation study. These suggestions did not alter the existing system, but were retained for study during the alternate system testing.

The Berkley Pit By-Pass was the only project requiring revision of the 1970 link network. The changes are illustrated in Figure V-1. Minor speed changes were coded along Grand Street and Harrison Avenue south of IR15-90. Grand Street was increased three (3) to five (5) miles per hour depending on the 1970 speeds. Harrison Avenue speeds south of IR15-90 were actually decreased in speed. This resulted because the nature of the route is changing from rural to strip commercial. Coded speeds were reduced from an average of 45 miles per hour to 30 to 35 miles per hour depending upon the location. For detailed link-by-link coded data the reader is referred to the Existing Plus Committed Historical Record computer printout, dated October 4, 1972.

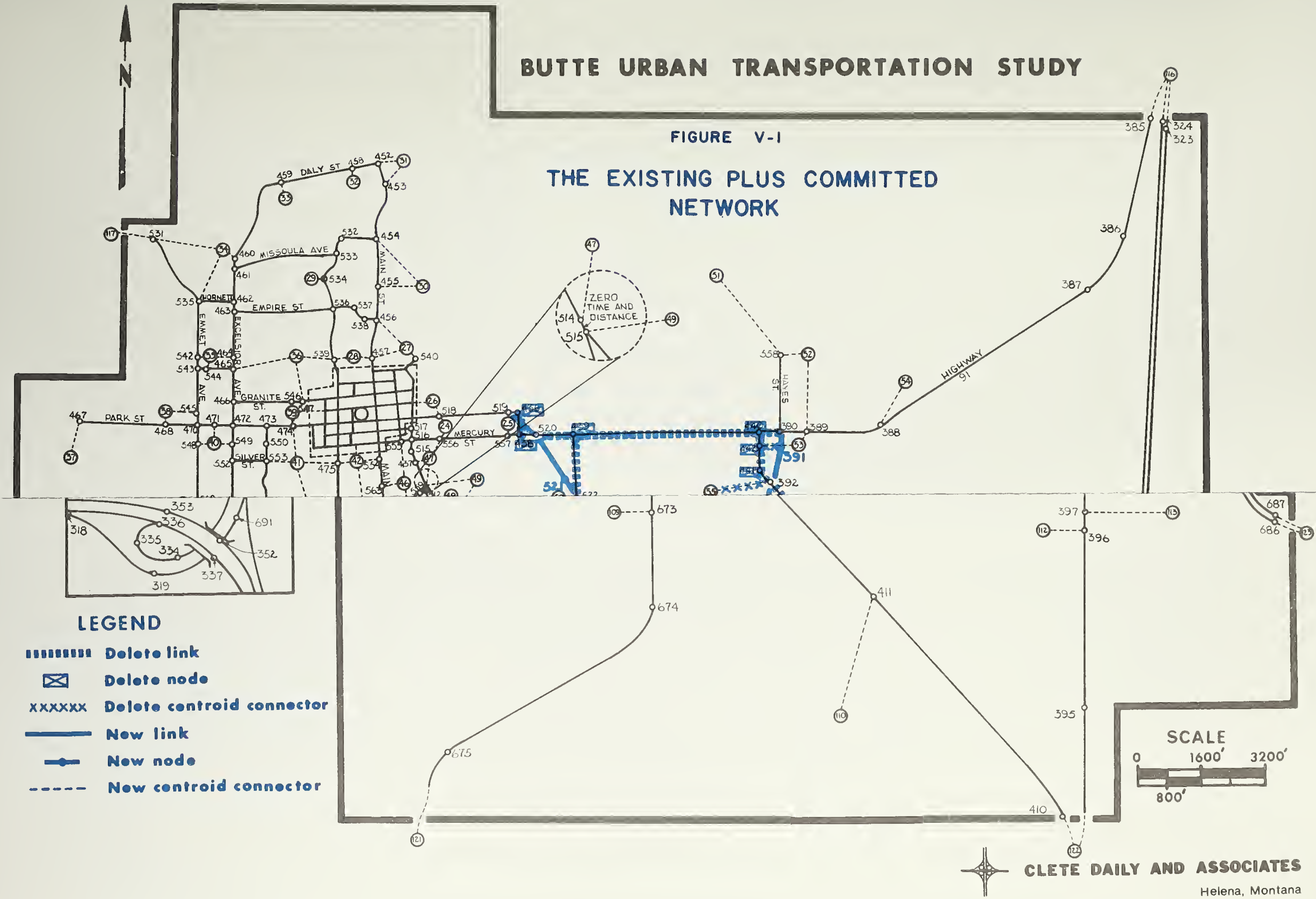
Figure V-1 illustrates the Existing Plus Committed Network.

Chapter VI of this report discusses the results of the traffic assignment of 1990 trips to the existing plus committed network.

BUTTE URBAN TRANSPORTATION STUDY

FIGURE V-1

THE EXISTING PLUS COMMITTED NETWORK



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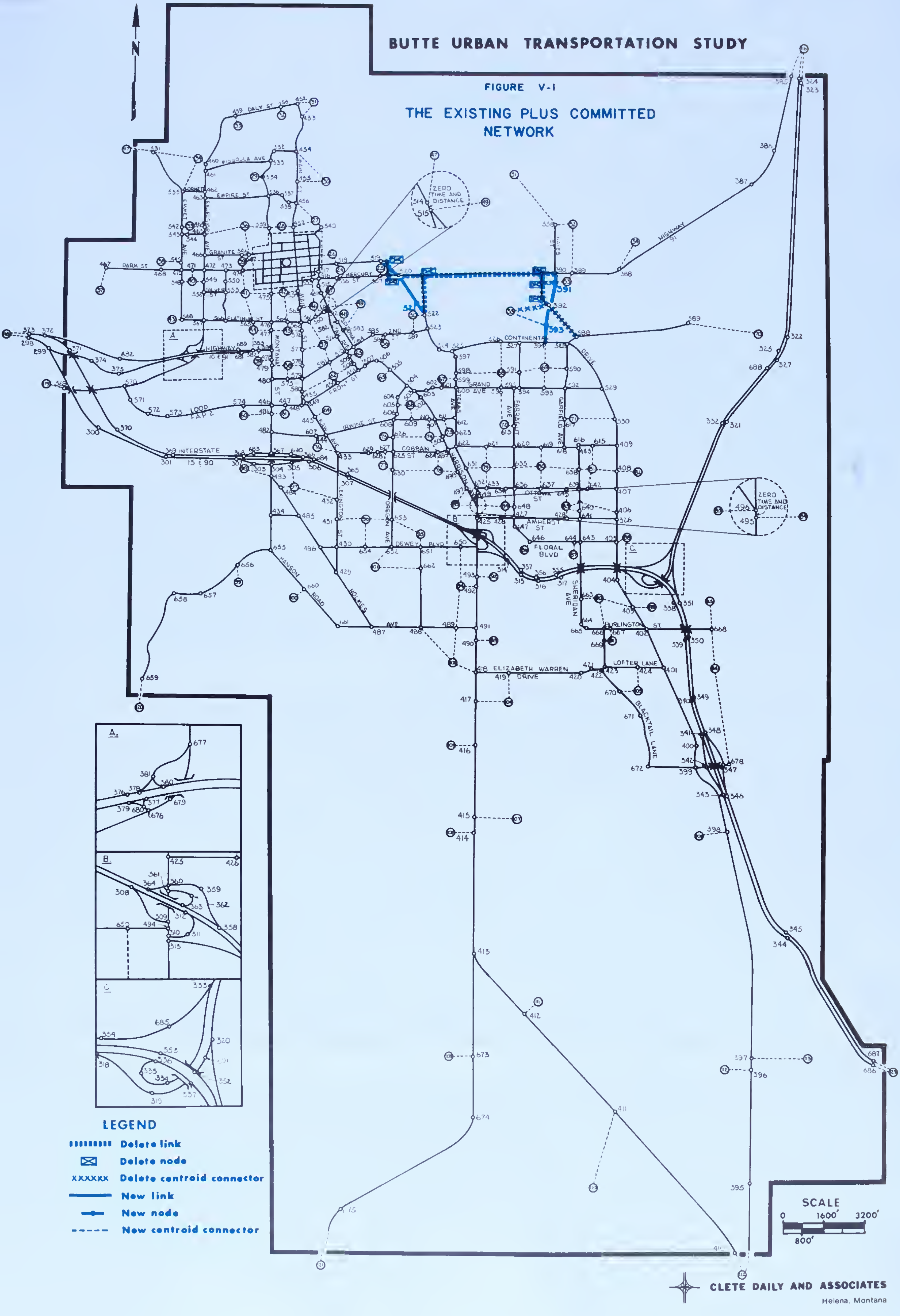
BUTTE URBAN TRANSPORTATION STUDY

FIGURE V-I

THE EXISTING PLUS COMMITTED NETWORK



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CHAPTER VI

TRAFFIC ASSIGNMENT

1990 TRIPS TO

EXISTING PLUS COMMITTED SYSTEM

TRAFFIC ASSIGNMENT
1990 TRIPS TO
EXISTING PLUS COMMITTED
SYSTEM

RESULTS

The 1990 trip productions and attractions generated by the trip generation equations and presented in Table IV-2 of this report were input to the calibrated gravity model for trip distribution. Output from the six models were combined into one computer tape using the GENPUR program. The resulting 1990 trip table was loaded (i.e. assisgned) to the existing plus committed highway system. The purpose of this chapter is to document the results of that traffic assignment and to describe how it aided in selection of the future alternate highway systems.

Table VI-1 lists and describes each traffic assignment carried out for the Butte Urban Transportation Study. Two assignments were made to the existing plus committed system using Land Use Plan Number 2. The assignment described in this chapter is referred to as II-6.

Figure VI-1 illustrates the existing plus committed highway system and a link-by-link comparison between 1972 average daily traffic and 1990 assigned traffic volumes. The map is color coded to indicate whether the 1990 assigned volumes are larger or smaller than the 1970 average daily traffic. Symbols along each route indicate the degree

TABLE VI-1

TRAFFIC ASSIGNMENTS FOR BUTTE URBAN TRANSPORTATION STUDY

Traffic* Assignment Number	Remarks
I-1 to I-9	Network loadings and corrections to the base year network, loaded with base year trip tables.
I-10	Final 1970 network loading using base year trip table.
II-1 to II-3	Network loadings of 1990 Land Use Plan Number 1 trips to the existing plus committed system. Rejected because of failure of FRATAR program on through trips.
II-4	Network loading of 1990 Land Use Plan Number 1 trips to the existing plus committed system. TRIPTAB (instead of FRATAR) used to tabulate through trips.
II-5	Network loading of 1990 Land Use Plan Number 2 trips to the existing plus committed system. Rejected because GENPUR program did not operate properly and all trips were not loaded.
II-6	Network loading of 1990 Land Use Plan Number 2 to the existing plus committed system. Accepted.
III-1	Network loading of 1990 Land Use Plan Number 2 trips to first alternate future test system. Rejected because GENPUR program did not operate properly and all trips were not loaded.
III-2	Network loading of 1990 Land Use Plan Number 2 trips to first alternate future test system. Accepted.
III-3	Network loading of 1990 Land Use Plan Number 2 trips to second alternate future test system. Accepted.
III-4	Network loading of 1990 Land Use Plan Number 2 trips to third alternate future test system. Accepted as basis for development of a transportation plan for Butte Urban Transportation Study.

* I refers to Base Year, i.e. 1970

II refers to 1990 trips loaded to the existing plus committed system.

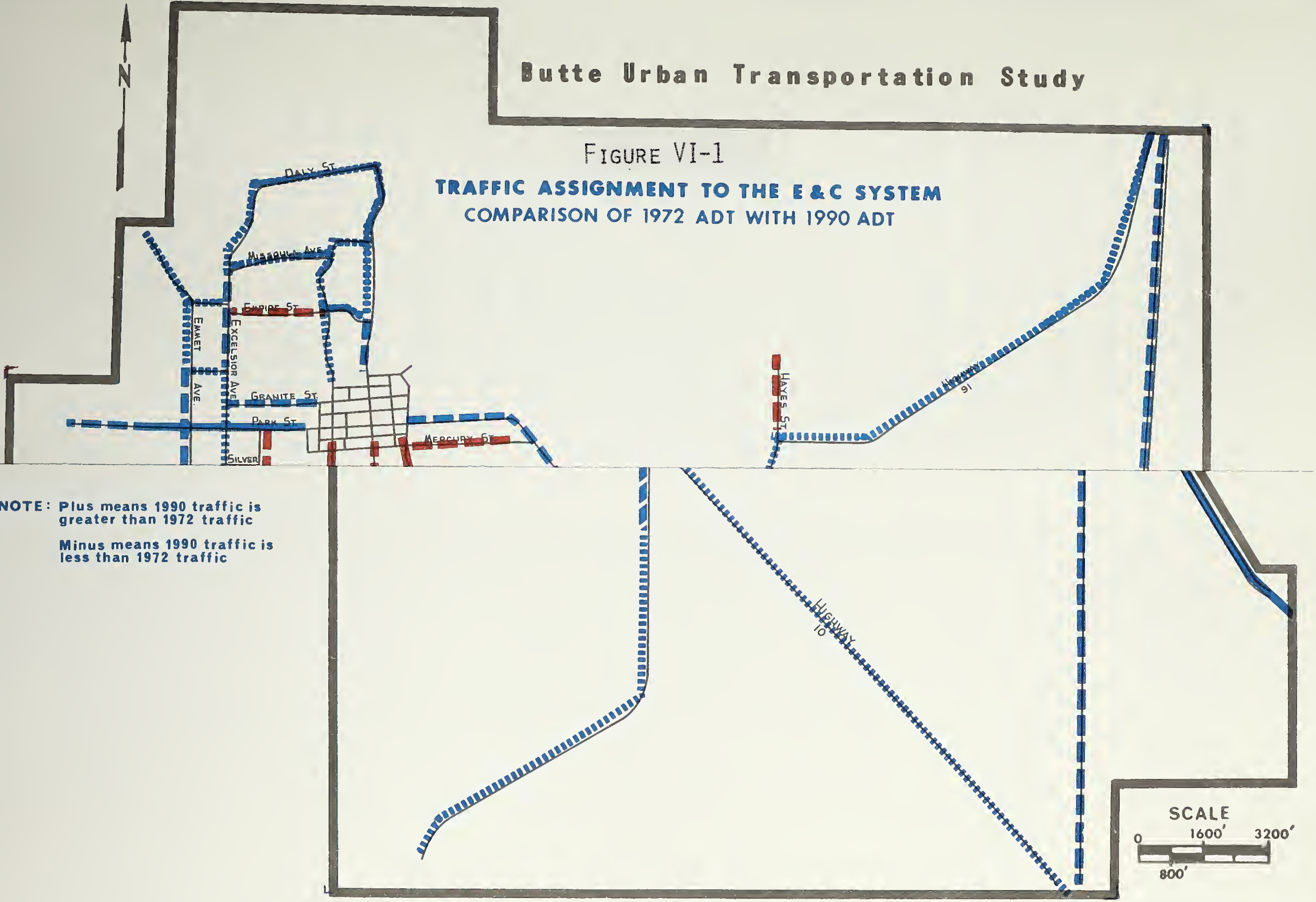
III refers to 1990 trips loaded to 1990 alternate networks.

Butte Urban Transportation Study

FIGURE VI-1

TRAFFIC ASSIGNMENT TO THE E & C SYSTEM

COMPARISON OF 1972 ADT WITH 1990 ADT



NOTE: Plus means 1990 traffic is greater than 1972 traffic

Minus means 1990 traffic is less than 1972 traffic

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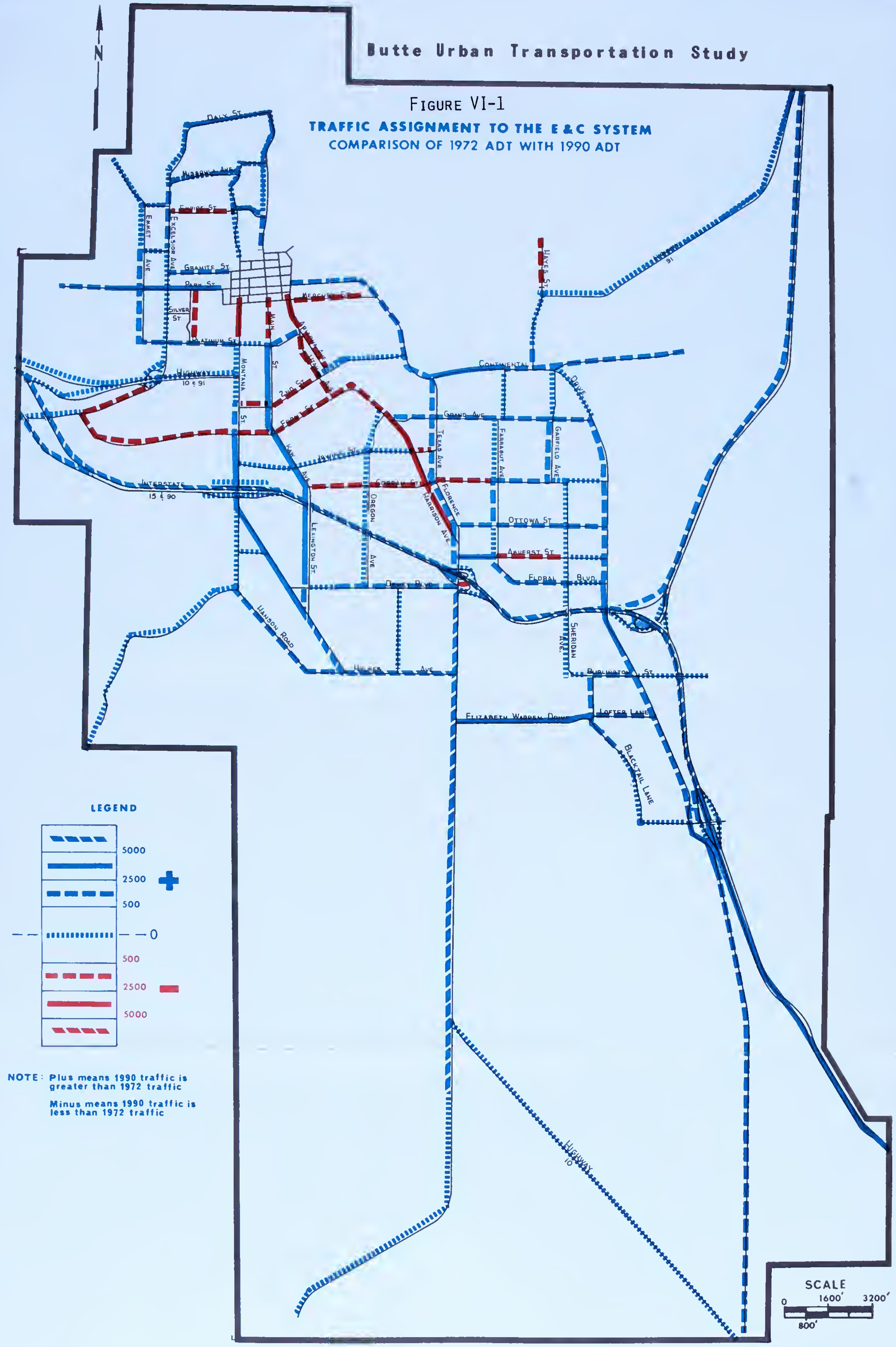
FIGURE VI-1

TRAFFIC ASSIGNMENT TO THE E&C SYSTEM
COMPARISON OF 1972 ADT WITH 1990 ADT



NOTE: Plus means 1990 traffic is greater than 1972 traffic

Minus means 1990 traffic is less than 1972 traffic

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of difference between two volumes. It is readily observed that major traffic increases occur on Harrison Avenue south of the interstate, Holmes Avenue-Rowe Road from Lexington Street to Harrison Avenue, and Interstate Route 15 and 90. Each of those routes show increases in excess of 5000 vehicles per day. The individual link exhibiting the highest 1990 volume is in front of the Plaza Shopping Center with 24,600 vehicles per day compared with 15,000 vehicles per day in 1972. Other arterial streets showing traffic increases are Main Street-Kaw Avenue, Park Street, and Continental Drive.

All routes showing significant traffic decreases are located north of the interstate. The reason is because the central business district was not changed materially between 1970 and 1990 while most new employment was distributed to newer developing sections in the southern area. Also, there was a general shift of households from the north areas to the southern "flats". As a result, Harrison Avenue near Albertson's Shopping Center and the Civic Center shows a decrease of about 2900 vehicles per day. A few other routes in the vicinity of the central business district show slight traffic decreases.

Table VI-2 lists both 1970 and 1990 trip ends to a few specific areas. Each of these areas show increases. The two zones exhibiting the highest increases (zones 92 and 109) are located south of the interstate along Harrison Avenue.

TABLE VI-2

COMPARISON OF 1970 ORIGIN-DESTINATION TRIP ENDS WITH 1990 TRAFFIC ASSIGNMENT

Zone(s)	Location	1970 Origin Destination Trip Ends	1990 Traffic Assignment	Increase
1-23	Central Business District	21,200	24,596	3,396
38	Montana Tech	4,952	7,846	2,894
55	Concentrator	801	1,302	501
92	Plaza Shopping Center	11,030	18,289	7,259
107	Municipal Airport	822	1,519	697
109	Port of Butte	0	7,312	7,312

Table VI-3 reflects the projected changes at each of the seven screen line crossings. The two interstate crossings are expected to show maximum increases of 175 percent. Arterial streets show substantial increases except for Harrison Avenue. It will become more highly congested during the planning period, and without needed improvements, begin to show traffic decreases by 1990.

TABLE VI-3

SCREENLINE COMPARISONS FOR

1990 EXISTING PLUS COMMITTED LOADING

Screenline Station Number	Location	1970 Ground Count	1990 Traffic Assignment	Difference Number	Difference Percent
1	IR15-90 just west of Montana Street	5,769	15,884	+10,115	+175.3
2	Montana Street south of Front Street at B.N. Railroad tracks	8,218	12,610	+ 4,392	+ 53.4
3	Kaw Avenue south of Front Street at BN Railroad overpass	6,564	9,464	+ 2,900	+ 44.2
4.	Harrison Avenue at BN Railroad overpass	17,086	15,828	- 1,258	- 7.3
5	Continental Drive south of Second Street at BN Railroad overpass	6,144	10,491	+ 4,347	+ 70.7
6	Stuart Street north of Montgomery Road at BN Railroad tracks	2,644	5,617	+ 2,973	+112.4
7	IR15 north of IR15-90 junction	923	2,522	+ 1,599	+173.2
TOTAL		47,348	72,416	+25,068	+ 52.9

SERVICE VOLUME ANALYSES

The ability to accomodate traffic is a principal consideration in both the planning and operation of streets and highways. A measure of the effectiveness of this ability to accomodate traffic is the service volume. It is defined as the maximum number of vehicles that can pass over a given section of a lane or roadway in one direction during a specified time period while selected operating conditions prevail on the section under study. A measure of the adequacy of an intersection can be obtained by comparing the demand volume to the service volume. This is done by calculating the ratio of Demand Volume to Service Volume, or DV/SV. When this ratio exceeds 1.00, the intersection approach has a demand volume exceeding the service volume. If the ratio falls between 0.80 and 0.99, the link in question is approaching critical operation.

The ratio DV/SV was computed for all existing signalized intersections and all potential signal locations using 1990 volumes as assigned to the existing plus committed highway system. Level of Service C was used for the service volume calculations. The objective was to determine all locations within the study area that would either be critical or approaching critical operation if 1990 traffic were operating there today.

Three locations were found to have DV/SV ratios greater than 1.00, while seven others indicated ratios between 0.80 and 0.99. These are listed in Table VI-4.

TABLE VI-4

CRITICAL LOCATIONS

Location	Direction	DV/SV*
Montana and Park Streets	East Bound	1.18
Harrison Avenue and Holmes Avenue	East Bound	1.77
Harrison Avenue and Elizabeth Warren Dr.	West Bound	1.09
Harrison Avenue and Roosevelt	South Bound	0.90
Harrison Avenue and Amherst Street	North Bound	0.87
Holmes Avenue and Lexington	Northwest Bound	0.81
Montana Street and Front Street	North Bound	0.95
Kaw Avenue and Cobban Street	South Bound	0.88
Harrison Avenue and Grand Avenue	West Bound	1.07
Continental Drive and Concentrator Road	East Bound	0.88

*DV/SV = Ratio of Demand Volume to Service Volume at Level of Service C

Forecasted 1990 traffic on the existing system shows deficiencies along Harrison Avenue from Holmes Avenue to the Mountain View Cemetery. Demand volume to service volume ratios ranged from 1.86 near Holmes Avenue to 1.16 immediately north of the cemetery. The section from Mountain View Cemetery to the municipal airport entrance was approaching critical conditions with a ratio of 0.91. However, these critical conditions will be relieved by the committed project schedulted for July, 1976. That improvement calls for reconstruction of Harrison Avenue to four (4) traffic lanes from IR15-90 to Basin Creek Road (FAS 393). It is concluded that the existing plus committed system

traffic assignment of 1990 traffic supports the need for upgrading south Harrison Avenue.

The remaining deficiencies will be used to help choose the 1990 transportation plan. That plan must relieve traffic congestion, provide for rapid, efficient, and safe movement of both people and cargo, and have minimal impact on the physical and social environment. Discussion of the alternate highway systems will be covered in a forthcoming report, entitled, "Butte Urban Transportation Plan".

SELECT LINK ANALYSES

Four network links were chosen from the existing plus committed network for an in depth examination of the trips crossing that particular link. The locations of these links are given in Table VI-5 and illustrated in Figure VI-2.

TABLE VI-5

SELECT LINK LOCATIONS AND TOTAL CROSSINGS

Link No.	Street	Location	Total Trip Crossings
1	Harrison Avenue	Just south of IR15-90; Between nodes 313 and 493	24,610
2	Harrison Avenue	Near BN Railroad overpass; Between nodes 505 and 506	15,828
3	Montana Street	Just north of IR15-90; Between nodes 367 and 482	12,697
4	Park Street	Just east of Excelsior; Between nodes 472-473	8,283

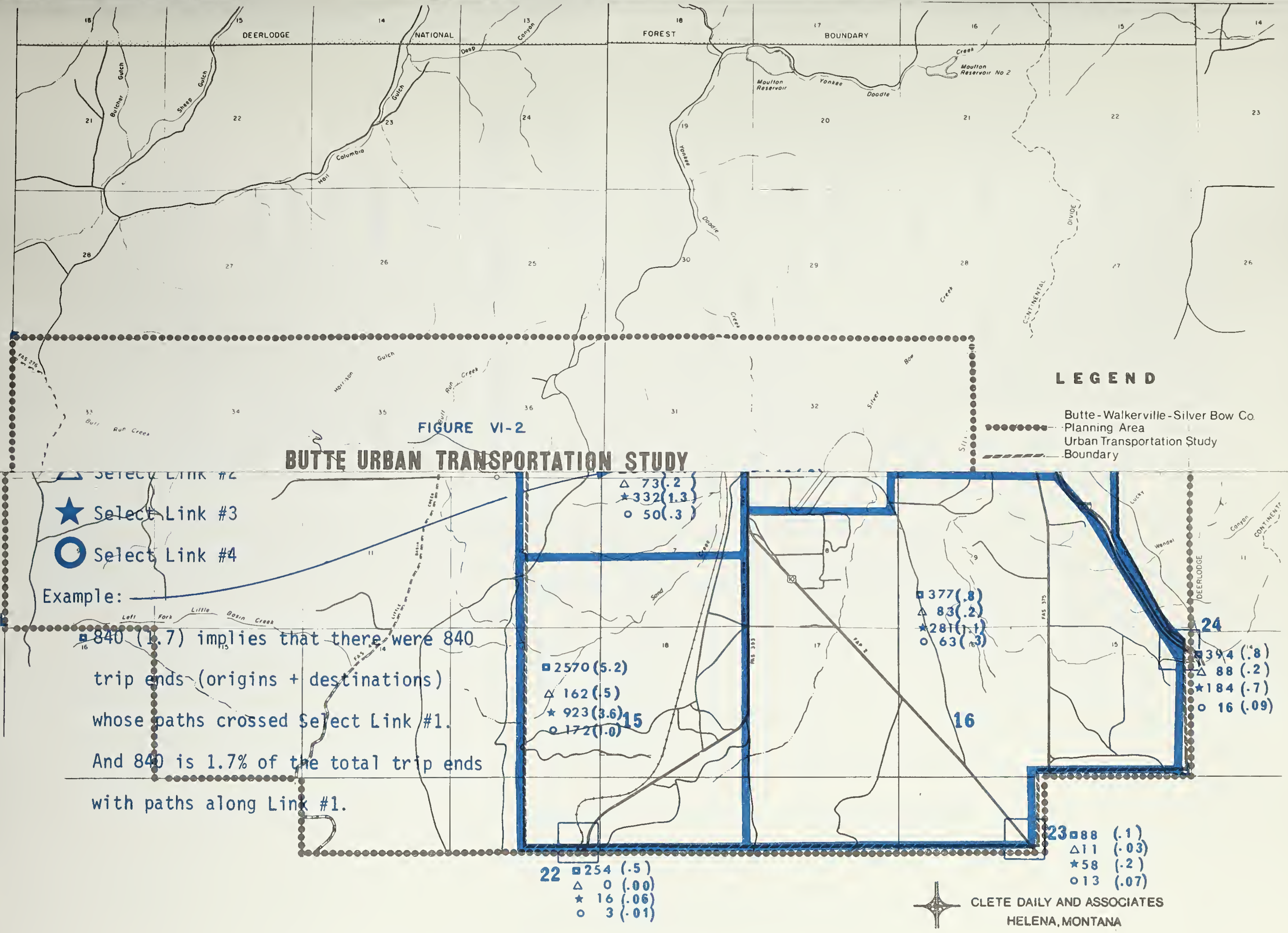

FIGURE VI-2

BUTTE URBAN TRANSPORTATION STUDY

LEGEND

Butte-Walkerville-Silver Bow Co. Planning Area

Urban Transportation Study Boundary

△ Select Link #2

★ Select Link #3

○ Select Link #4

Example: □ 840 (1.7) implies that there were 840 trip ends (origins + destinations) whose paths crossed Select Link #1. And 840 is 1.7% of the total trip ends with paths along Link #1.

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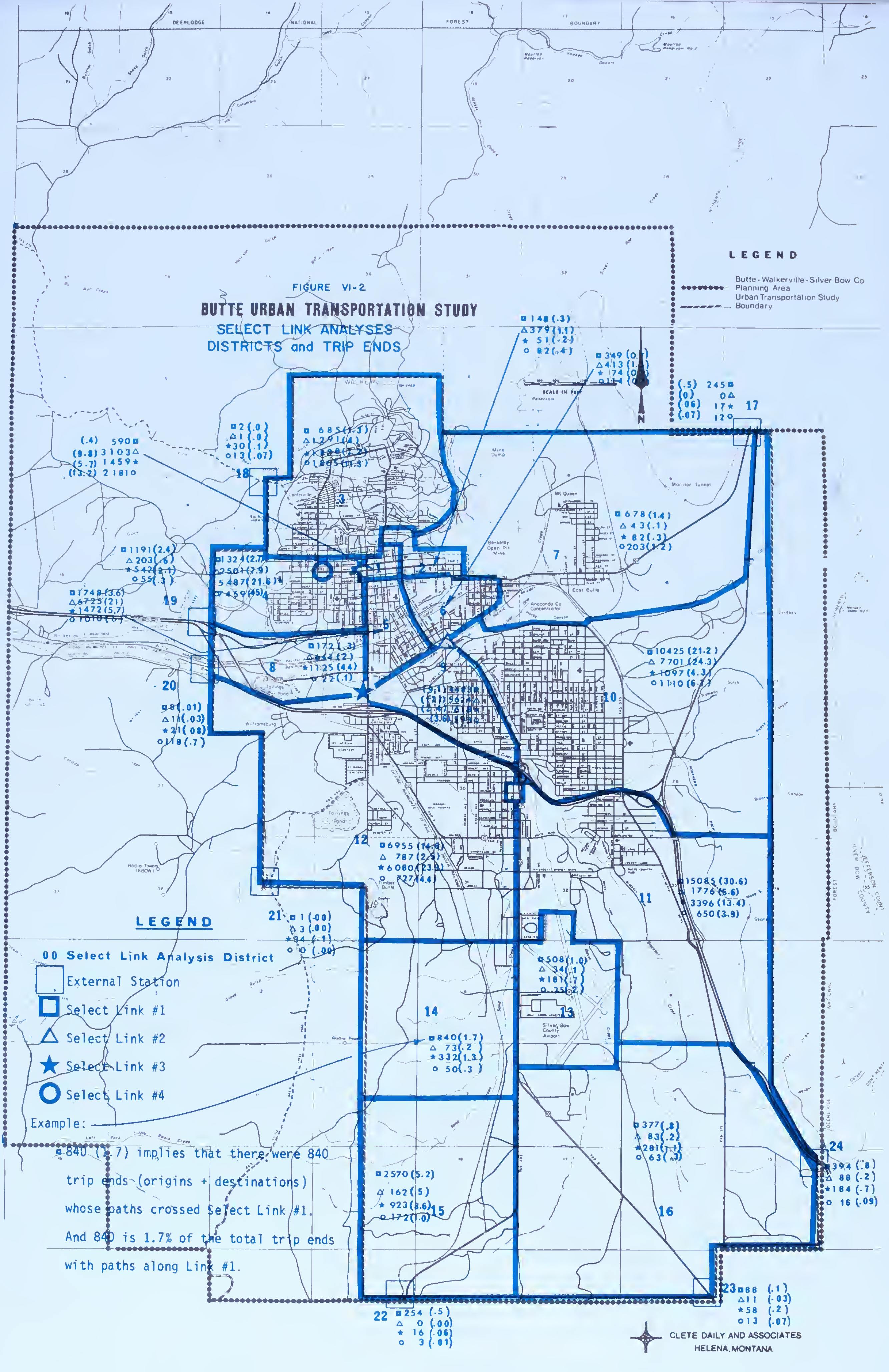

FIGURE VI-2

BUTTE URBAN TRANSPORTATION STUDY

SELECT LINK ANALYSES DISTRICTS and TRIP ENDS

LEGEND

- •••••• Butte-Walkerville-Silver Bow Co Planning Area
- – – – Urban Transportation Study Boundary

LEGEND

- 00 Select Link Analysis District
- ☐ External Station
- ◻ Select Link #1
- △ Select Link #2
- ★ Select Link #3
- ○ Select Link #4

Example:

◻ 840 (1.7) implies that there were 840 trip ends (origins + destinations) whose paths crossed Select Link #1. And 840 is 1.7% of the total trip ends with paths along Link #1.

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Using computer program SELINK, the path of each trip crossing the selected link was traced on the existing plus committed network. Traffic volumes on all links throughout the study area resulting from trips crossing the selected link were determined. Plots of these volumes are shown in Figures VI-3 through VI-6. Each of these assignments will be individually discussed below.

A second examination was made. The study area was divided into sixteen (16) districts and the eight (8) cordon line stations. Origins and destinations for all trips crossing the selected link are totaled for each of the districts and cordon stations. Figure VI-2 illustrates the district boundaries and the corresponding trip ends from each link to (and from) that district. The percentage of the total is given for each district.

Examination of Figures VI-2 through VI-6 yield the following conclusions:

Select Link Number 1: Harrison Avenue south of IR15-90

-The majority of the trips crossing this link extend directly north of IR15-90 along Harrison Avenue. This is reasonable because 21.3 percent of the trips transfer between districts 10 and 11 which indicates that relief to Harrison Avenue in the vicinity of the interchange could be provided by improving the means of travel between these two districts.

-IR15-90, between Harrison Avenue and Montana Street, is used for travel to districts north of the interstate and to the central

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FIGURE VI-3

Select Link #1

Traffic Assignments

Harrison Avenue

South of IR 15-90

Link Nodes # 493-313

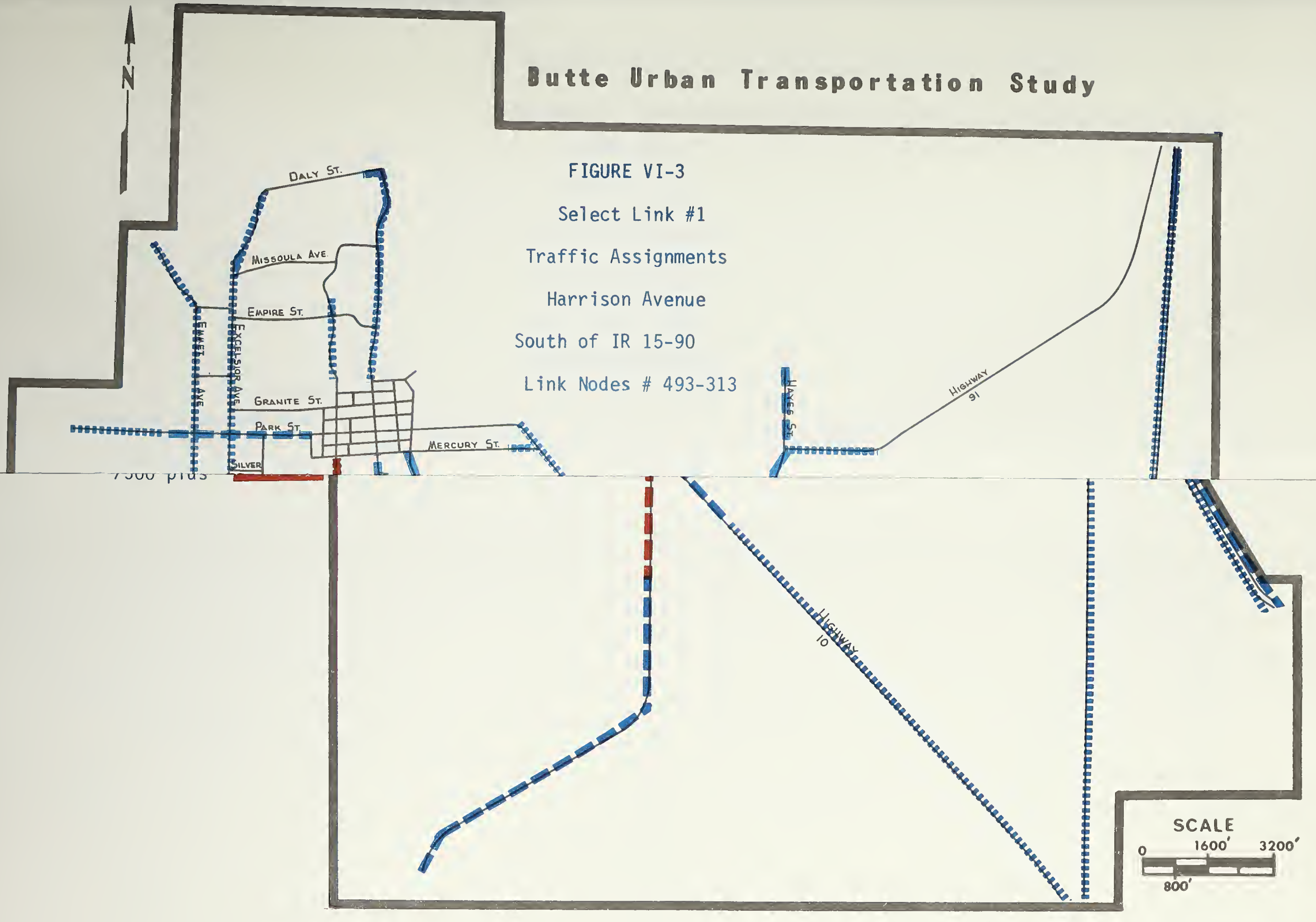

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FIGURE VI-3

Select Link #1

Traffic Assignments

Harrison Avenue

South of IR 15-90

Link Nodes # 493-313

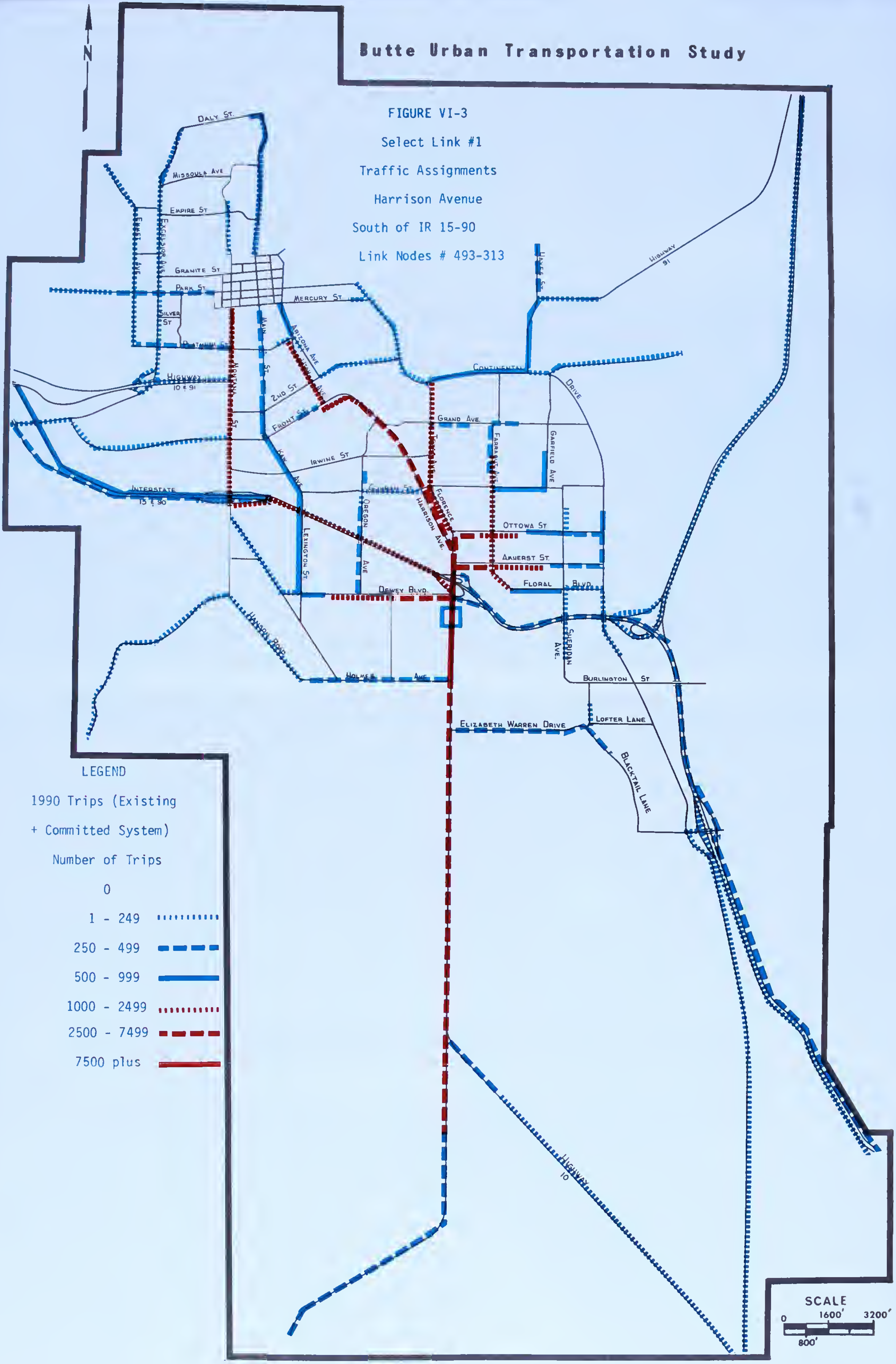

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FIGURE VI-4

Select Link #2

Traffic Assignments

Harrison Avenue

near Civic Center

Link Nodes # 505-506

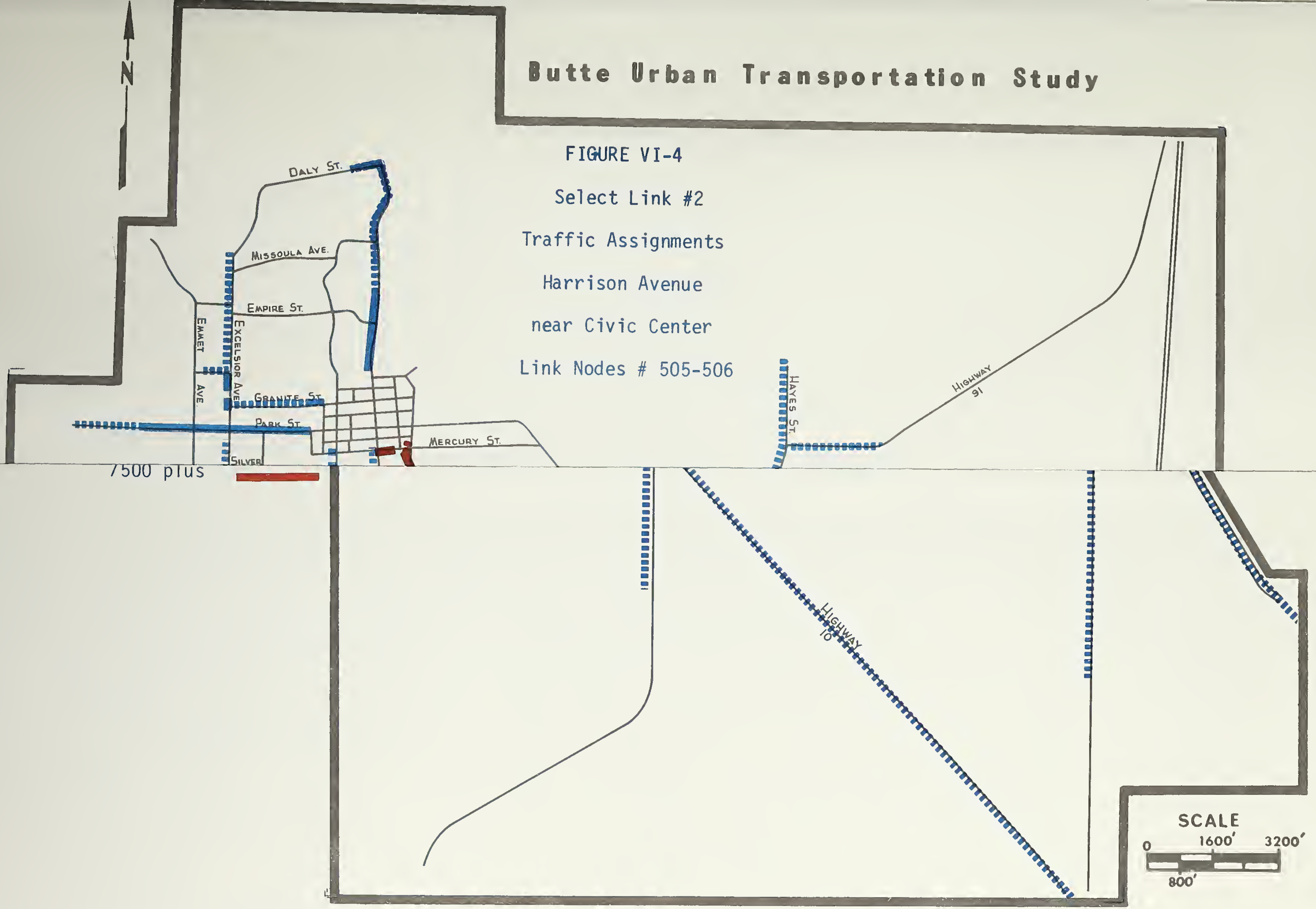

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FIGURE VI-4

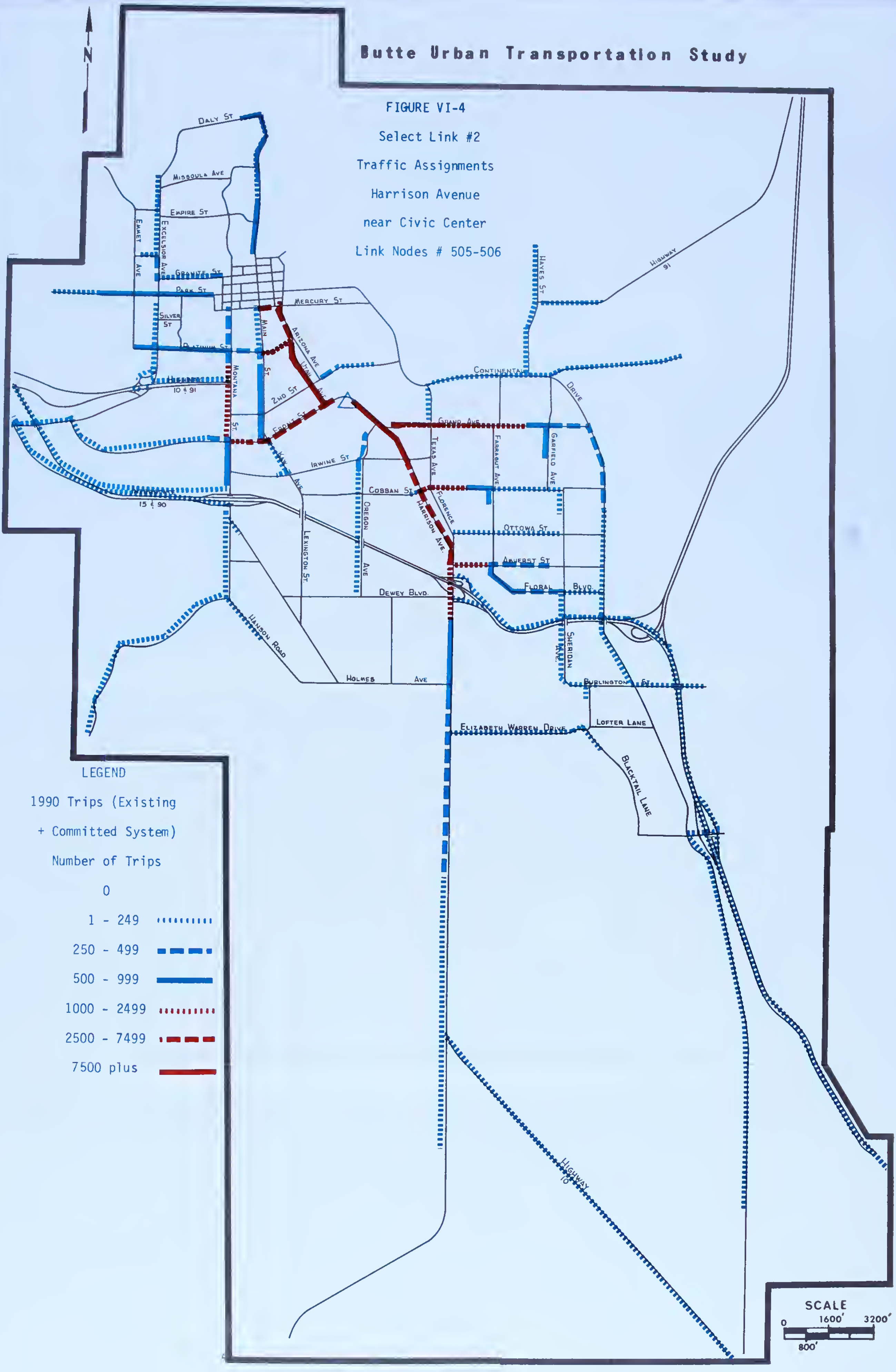
Select Link #2

Traffic Assignments

Harrison Avenue

near Civic Center

Link Nodes # 505-506



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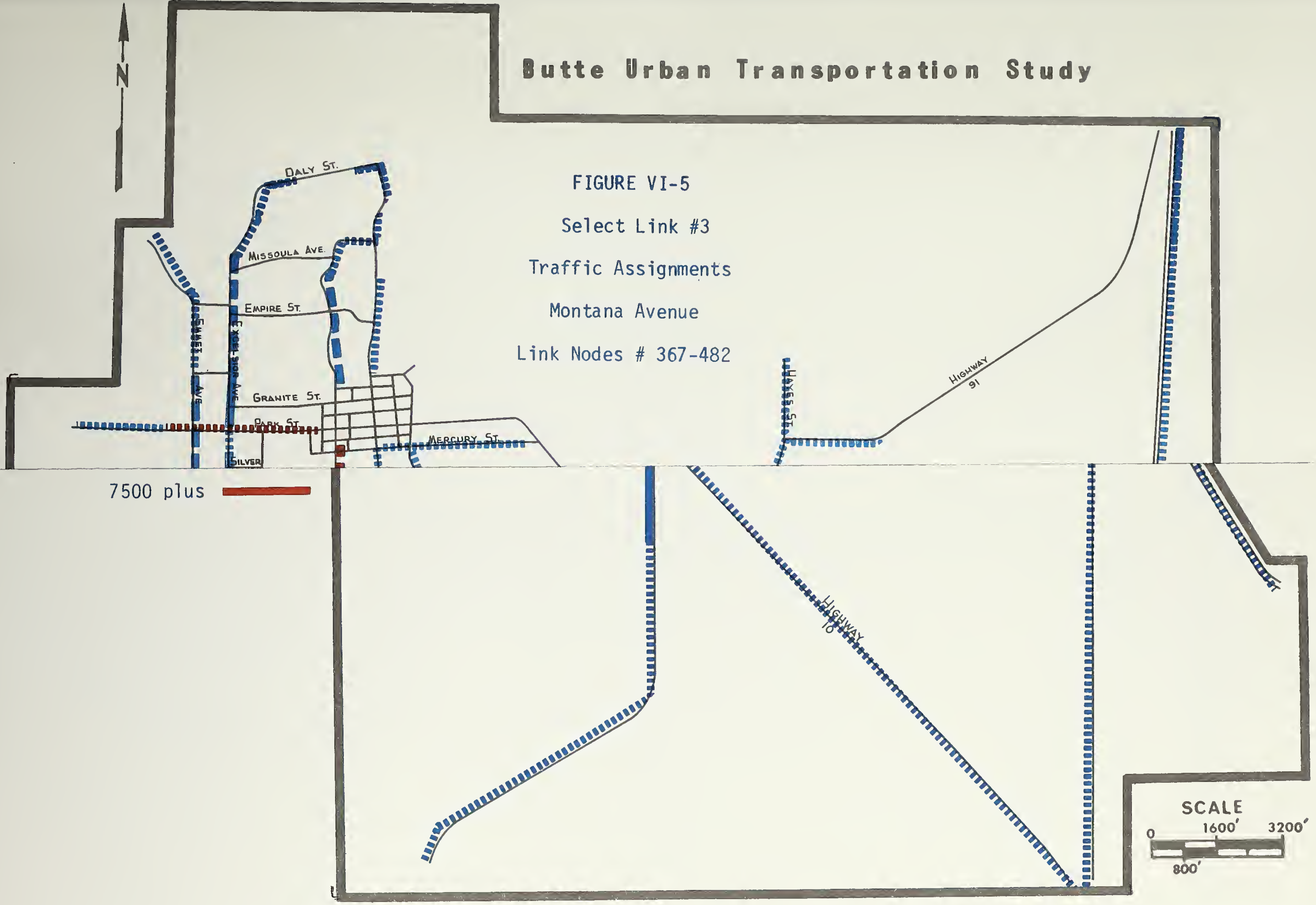

FIGURE VI-5

Select Link #3

Traffic Assignments

Montana Avenue

Link Nodes # 367-482

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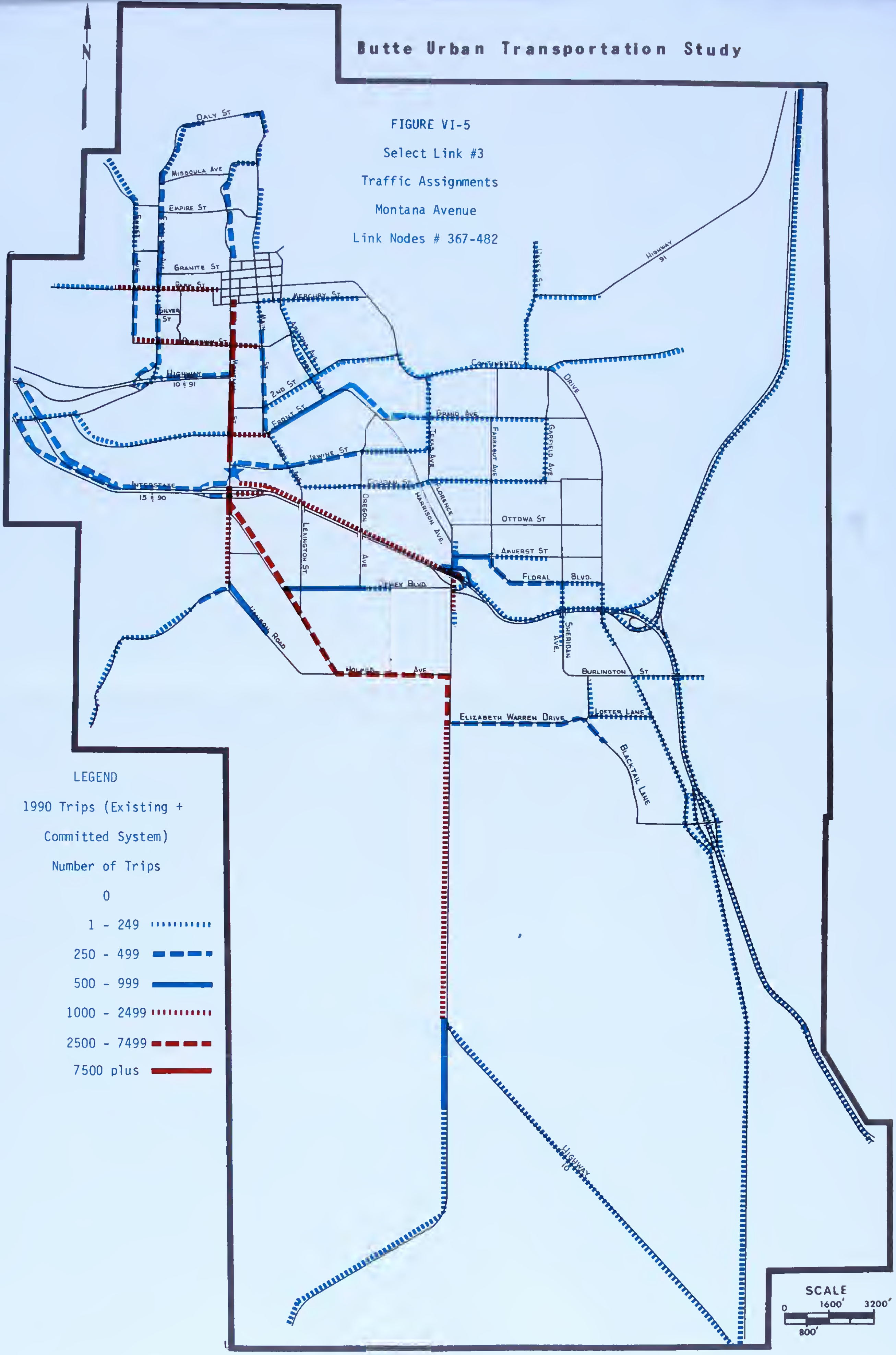
FIGURE VI-5

Select Link #3

Traffic Assignments

Montana Avenue

Link Nodes # 367-482



LEGEND

1990 Trips (Existing + Committed System)

Number of Trips

0

1 - 249 ┆┆┆┆┆┆┆┆

250 - 499 ▬ ▬ ▬

500 - 999 ━━━━

1000 - 2499 ┆┆┆┆┆┆┆┆

2500 - 7499 ▬ ▬ ▬

7500 plus ━━━━

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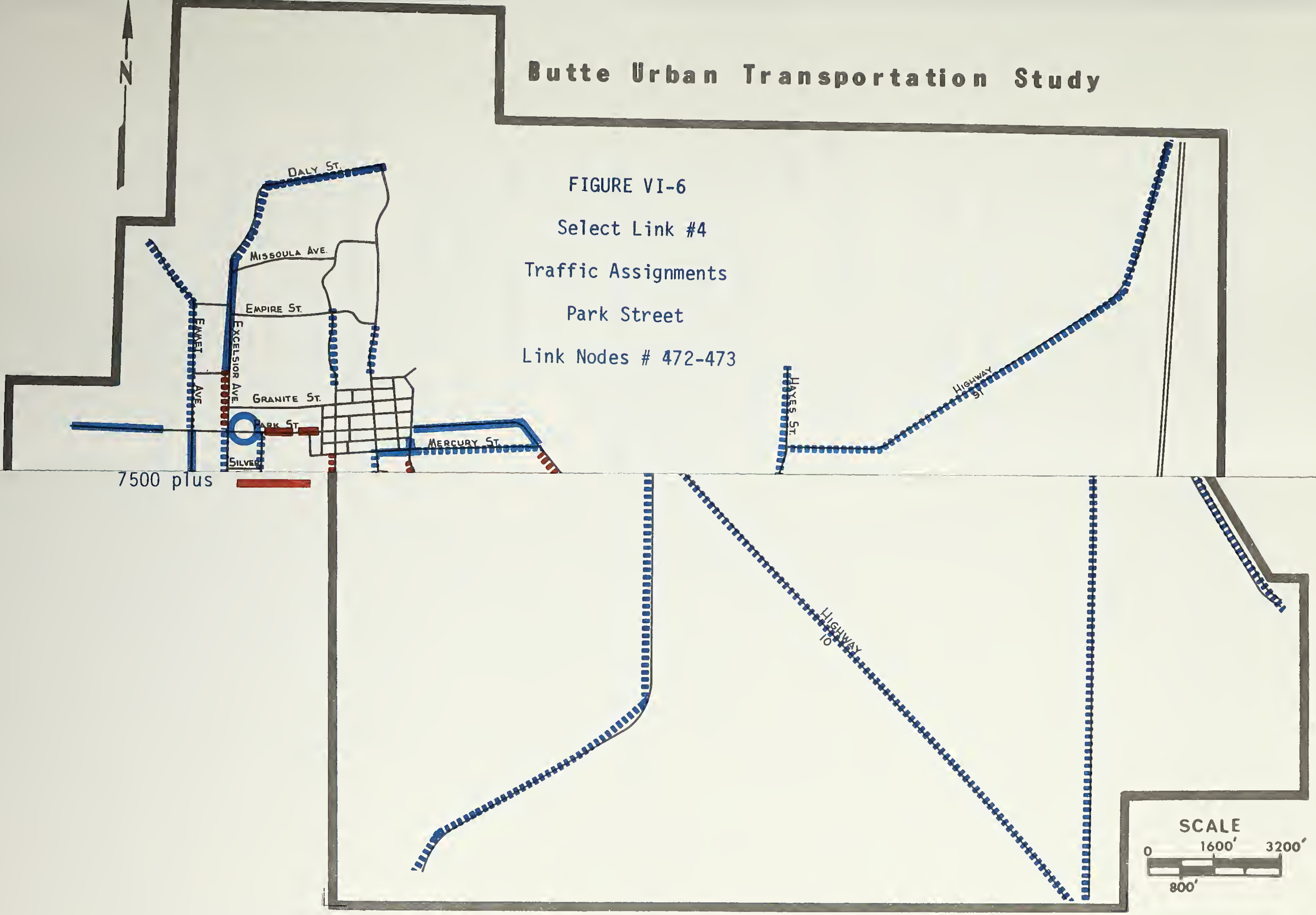
FIGURE VI-6

Select Link #4

Traffic Assignments

Park Street

Link Nodes # 472-473



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Helena, Montana

Butte Urban Transportation Study

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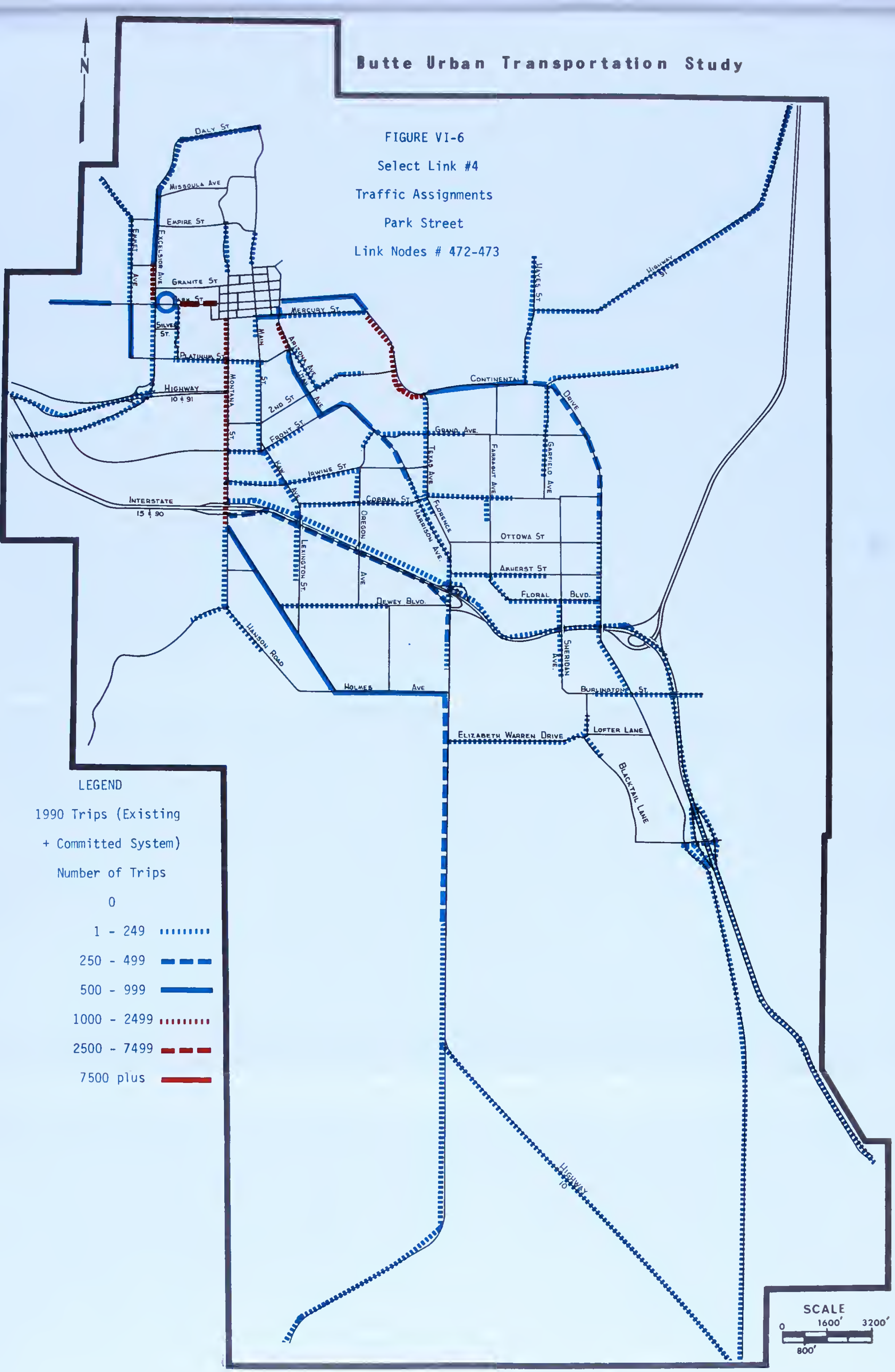

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Helena Montana

business district. This indicates that some Butte area residents are using the freeway for local travel.

-Using the method of moments, the centroid of all trip destinations both north and south of the interstate and crossing along Harrison Avenue was determined for both 1970 and 1990 trips. A straight line between these centroids for 1990 travel, lies 800 feet west of the present interchange. This indicates that the optimum crossing point is very close to the existing interchange.

Select Link Number 2: Harrison Avenue at Burlington Northern Railroad Overpass

-78.1 percent of the trips crossing this link interchange between the group of districts 1 through 8 and districts 9 and 10. This is supported by Figure VI-4 which shows the highest volumes along upper Harrison Avenue, Grand Street, Utah-Arizona Avenues, and Front Street.

-Only 16.1 percent of the origins and destinations from districts 1 through 8 (i.e. north of Front Street) cross this link and extend south of the interstate to districts 11 through 16.

Select Link Number 3: Montana Street just north of IR15-90

-Trips crossing this link extend north and south predominately using Park Street, Platinum Street, Montana Street, Rowe Road, Holmes Avenue, and the interstate.

-42.3 percent of the trips transfer between the group of districts

1 through 8 and district 12, while another 26.7 percent of the trips use IR15-90 and exchange between districts 1 through 8 and district 11. This indicates that Butte area residents are beginning to use the interstate for local travel, thus providing some relief to arterial routes.

-Figure VI-2 shows the optimum interstate crossing points for all trips using Montana Street for both 1970 and 1990 trips. The 1990 crossing is 2000 feet east of Montana and has shifted 800 feet westward since 1970. The reason for the movement to the west is due to shifting of the centroid (south of IR15-90) approximately 2200 feet further south. This indicates that travel in the Butte area is forecasted to shift toward the south during the planning period.

Select Link Number 4: Park Street just east of Excelsior Avenue

-Travel across this link extends nearly equally (southward) using Montana Street, Utah-Harrison Avenues, and Continental Drive.

-37.2 percent of the trips crossing this link exchanged between districts 3 and 4 and districts 9 through 12, indicating a signif - cant amount of travel to the Harrison Avenue strip commercial areas.

CONCLUSIONS

Results of loading 1990 traffic to the existing plus committed highway system indicate the following transportation needs for the Butte urban area:

-Improvement of Harrison Avenue from Front Street to IR15-90 to relieve congestion and to decrease travel times along this corridor.

-Widening Harrison Avenue to four (4) lanes from IR15-90 to FAS 393. This is presently a committed project.

-Residential and commercial growth is occurring in zones south of the interstate. Harrison Avenue serves as the major corridor to the uptown, Walkerville, and the Montana College of Mineral Science and Technology. An alternate north-south traffic corridor to the west of Harrison Avenue should be examined during testing of future transportation systems.

-Industrial uses are expanding into areas south of the interstate. Designated truck routes are needed to help remove heavy, truck traffic from arterial streets.

-Elizabeth Warren Drive serves as the only connection between Harrison Avenue and Continental Drive south of IR15-90. Alignment along this route is restricted because it crosses over the Country Club golf course and adjacent to the clubhouse. Also, this drive may eventually be closed as a through route if airport runway 15-33 is extended to the north. An alternate east-west route should be tested, and the closer its location is to IR15-90, the more relief it will provide for Harrison Avenue at the interstate interchange.

-An alternate east-west collector route in the vicinity of Grand Avenue should be studied and tested.

-Park Street is the major connector between the Montana College of Mineral Science and Technology and the uptown. Alignment is poor and the route is in need of general upgrading. Improvements should be tested.

-The Main Street-Kaw Avenue corridor shows traffic increases. Improvements should be examined and tested.

Alternate system testing will be discussed in the fourth report entitled, "Butte Urban Transportation Plan".